

Making the Museum of Natural History and Environmental Culture in  
Mexico City more inclusive for vision impaired visitors:

Design Proposal

by

Alejandra Bortoni Breña

Submitted to OCAD University

in partial fulfillment of the requirements

for the Degree of

Master of Design

in

Inclusive Design

Toronto, Ontario, Canada, April, 2019

© Alejandra Bortoni Breña, 2019

This work is licensed under a Creative Commons Attribution 4.0 International License.

To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/4.0/> or write to Creative

Commons, 171, Second Street, Suite 300, San Francisco, California 94105, USA.

## Copyright notice

This document is licensed under Creative Commons Attribution - Non Commercial Works 4.0

License <http://creativecommons.org/licenses/bync/4.0/ca/>

You are free to:

Share: copy & redistribute the material in any medium or format

Adapt: remix, transform, and build upon the material

Under the following conditions:

Attribution: You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

Non-Commercial: You may not use this work for commercial purposes.

Notice:

You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation.

No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material.

## Author's Declaration

I hereby declare that I am the sole author of this Masters Research Project (MRP).

This is a true copy of the MRP, including any required final revisions, as accepted by my examiners.

I authorize OCAD University to lend this MRP to other institutions or individuals for the purpose of scholarly research.

I understand that my MRP may be made electronically available to the public.

I further authorize OCAD University to reproduce this MRP by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Signature \_\_\_\_\_

## Abstract

This Masters Research Project addresses the main research question, of how can the Museum of Natural History and Environmental Culture in Mexico City become a more inclusive space for Mexican visitors, with a vision impairment, through its interactions and learning experiences.

This research uses a Mixed Methods approach—combining design research techniques: In-Depth Ethnographic Interview, Shadowing, Contextual Interview, Observation, Co-Design, and User Test—all leading to a Design Proposal for the multisensory translation of one of the exhibits at the museum, a replicable Model to create future inclusive exhibits and a Strategic Roadmap of actions for the museum to become more inclusive. The Design Proposal for the multisensory translation was prototyped and then tested at the museum to evaluate its impact with the diverse visitors that enter the museum on a regular weekend as well as with visitors with a vision disability to ensure the final solution did offer inclusive interactions for all.

The purpose of the research is to contribute to the current state of Mexican museums as educational entities, where nowadays, regardless of them being private or public, little evaluation is done around the effectiveness of their educational interactions, and where there are none or little efforts done to become inclusive spaces that all kinds of visitors can benefit from. As a researcher, I intend to help this particular museum understand where it stands in terms of inclusion, and propose supports that contribute to the museum experiences for individuals with a vision aid, in a way there is benefit at a larger scope. I am motivated by this project because of my personal passion for museums, my concern for the low levels of education in Mexico, and my belief in these spaces as potential mediums for transforming the education experience.



## Acknowledgements

I want to acknowledge and thank my parents, Vicente Bortoni and Alejandra Breña, for their unconditional support and motivation during the process of researching and writing this MRP, and for listening to me talk about my ideas, discoveries and frustrations. I also want to thank them for always encouraging me to work towards creating a better country and society by the pursuit of my own passion, research. I want to thank my sisters, Regina Bortoni and Daniela Bortoni, for their tireless company that helped me regain motivation when I needed it, smile and enjoy the program the whole way. Thank you to my boyfriend and future husband, Cristóbal Iturbe, not only for his patience, but for being my side during this project, sharing my worries and actively getting involved in the research work. I want to thank each and every one of the participants in this research, for their full dedication to this project without seeking any reward, for trusting me and teaching me about their own perspectives. I acknowledge and thank the members of the *Museo de Historia Natural y Cultura Ambiental*, Mercedes Jiménez del Arco, Alejandro Camarena and all the staff from the Education Department for their interest, openness and candor all along this MRP process, also for their dedication to their own work that inspired me during this project. I want to give special thanks to my design colleagues who backed me up during the co-design sessions when I needed more hands to encompass all the work, and to those who voluntarily gave up their personal time to help me do sensemaking after each phase. I also want to thank Héctor Patricio for helping me with the programming of the final prototype that was tested. Thank you to my Principal Advisor, Jana Macalik, for constantly giving me direction and perspective regardless of the geographical distance. Thank you to my Secondary Advisor, Beverly Dywan, for her accurate feedback, for her inspiration and encouragement towards the museums' field, and for tirelessly giving me advice in the corrections of this paper. I also want to thank my boss and mentor, Benjamín Real, for showing sympathy for my work through the program, giving me freedom to attend commitments, even during work schedules. I want to thank my friends and colleagues from the Inclusive Design program for letting me know them, despite the distance, by sharing, discussing, collaborating and challenging; they made the two years enjoyable, enriching and worth the effort. Lastly, I want to thank my OCAD U professors of Inclusive Design, for teaching me about Inclusion and helping me to make a successful MRP.

## Dedication

For my new friends, participants in this project who have a vision disability, for the community of the vision impaired around the world, and for Mexico, my dear country.

## Table of contents

Copyright notice .....	ii
Author's declaration .....	iii
Abstract .....	iv
Acknowledgements .....	v
Dedication .....	vi
List of figures and illustrations .....	vii
Chapter one .....	1
Introduction .....	1
Problem.....	1
Chapter two .....	3
2. Environmental scan .....	3
2.1 Museums in Mexico City .....	3
2.2 The Museum of Natural History and Environmental Culture in Mexico City .....	5
2.3 Inclusion and education in museums world trends .....	7
Chapter three .....	12
3. Exploration .....	12
3.1 Stakeholders interviews .....	12
3.2 Observations.....	16

3.3 Contextual interviews .....	19
3.4 Staff interviews .....	22
3.5 Other perspectives .....	26
Chapter four .....	28
Visitors journey and fields of action .....	28
Sample selection and redefinition of research question .....	37
Research methods plan .....	40
Chapter five .....	41
5. Understand .....	41
5.1 Participant recruitment .....	41
5.2 Shadowing interviews .....	41
Chapter six .....	43
6. Sensemaking .....	43
6.1 Synthesis of findings and insights .....	43
6.2 Early ideation and desktop research .....	46
6.3 Definition of focus and scope .....	50
Chapter seven .....	56
7. Co-design .....	56
7.1 Plan and logistics .....	56

7.2 Co-design outputs .....	61
Chapter eight .....	73
Prototype .....	73
User Test .....	76
Refinement .....	83
Chapter nine .....	86
9. Deliverable .....	86
9.1 Model .....	86
9.2 Strategic roadmap .....	87
9.3 Conclusions .....	89
9.4 Next steps .....	97
Bibliography .....	99
Appendix .....	102
Appendix A. My MRP process in relation with divergent and convergent thinking .....	102
Appendix B. Timeline of museum during MRP .....	102
Appendix C. Participants sample for shadowing interviews .....	103
Appendix D. Code in Processing for prototype buttons .....	104
Appendix E. First round of participants ideas per field of action .....	105
Appendix F. Second round of participants ideas per field of action .....	106

Appendix G. User test complete report .....	108
Appendix H. Questionnaires .....	111
Appendix I. Complete list of dioramas in Megadiverse Mexico section .....	115

## List of Figures and Illustrations

Figure 1. Environmental scan: The MNHEC 1964 .....	6
Figure 2. Environmental scan: The MNHEC 2018 .....	6
Figure 3. Environmental scan: Facilities Assessment of main museums in Mexico City .....	7
Figure 4. Environmental scan: AGO inclusivity cart .....	10
Figure 5. Environmental scan: Tactile representations at Antiguo Colegio San Ildefonso .....	11
Figure 6. Visitors journey and fields of action: Visitors Journey Map at the MNHEC .....	28
Figure 7. Sample selection and redefinition of research question: Table of disabilities attended at each field of action .....	38
Figure 8. Sensemaking: Tactile map of exhibition and tactile video screen at Museum of Tomorrow .....	47
Figure 9. Sensemaking: Tactile map prototype at OCAD 2018 summer intensive exhibit .....	48
Figure 10. Sensemaking: Fields of action .....	50
Figure 11. Sensemaking: Diplodocus Dinosaur at the MNHEC .....	53
Figure 12. Sensemaking: Dioramas at the MNHEC .....	54
Figure 13. Co-design: Smell jars with forest elements, sacrificial concept .....	58
Figure 14. Co-design: Touch diorama in scale, sacrificial concept .....	58
Figure 15. Co-design: Step on and hear data about coral reef, sacrificial concept .....	59
Figure 16. Co-design: Move and hear jungle elements, sacrificial concept .....	59
Figure 17. Co-design: 4D experience of coniferous forest, sacrificial concept .....	60

Figure 18. Co-design: First sketch for diorama translation .....	66
Figure 19. Co-design: Translation of affordances and signifiers .....	71
Figure 20. Prototype: Second sketches of prototype .....	73
Figure 21. Prototype: Prototype Sketch .....	74
Figure 22. Prototype: Prototype of translation of Mountain Mesophyll Forest .....	75
Figure 23. Prototype: User testing prototype at MNHEC .....	80
Figure 24. Prototype: Sketch of refined iterated translation .....	83
Figure 25. Deliverable: Roadmap of Interventions for Inclusion at the MNHEC.....	88
Figure 26. Appendix A: My MRP Process in relation to divergent and convergent thinking....	102



# Chapter one

## Introduction

During recent years museums all over the world have taken inclusive approaches searching to broaden their audience and engage with more diverse groups of public. Initiatives vary from deep layers of service that require restructuring, to superficial layers of accessibility. Mexico City is known as the city with more museums in the world but is now found challenged to keep up with the inclusiveness provided by foreign museums. At the same time, museums in Mexico have the opportunity to have a high impact on education, one of the country's largest lags, and an interesting way of transforming their contributions could be to become inclusive. This Major Research Project (MRP) takes place at the Museum of Natural History and Environmental Culture in Mexico City (MNHEC), how it is positioned in the inclusivity context, its impact in society, its interactions and how these could become more inclusive.

## Problem

My initial approach towards working with the museum consisted of exploring to answer the research question:

How can the Museum of Natural History and Environmental Culture in Mexico City become a more inclusive space for Mexican visitors through interactions and learning experiences?

My short term goal was to analyze the types of interactions that happen at the MNHEC with its visitors, to identify gaps, barriers, and fields of action so that the project could evolve into the design of strategies for the museum to work on towards becoming a more inclusive space.

The museum was going through a remodelling phase when I first talked to the directors, so I had the chance to compare the interactions with the exhibitions, before and after the main exhibitions were rebuilt.

I used Design Thinking and user centered methods as an approach to this research; all along the process I shifted from divergent to convergent thinking. The process allowed me to redefine the problem as soon as I had enough information around the context and first diagnostic, so I was able to angle the research question towards a specific group of people and work from there. My research proposal was approved by the REB and didn't suffer any changes along the way, it was carried out without any constraints. The application process for an REB approval helped me develop the research methods used in this project because it taught me how to be respectful and inclusive with the participants as well as the data collected.

## Chapter two

### Environmental scan

#### Museums in Mexico City

In the 1970 there was boom in the establishment of new museums in Mexico City (National Museum of Anthropology, Modern Art Museum, National Museum of Viceroyalty, National Museum of Cultures), under the mission to extol the national values and cultural heritage of the country. The Museum of Natural History and Environmental Culture's establishment was also part of this context.<sup>1</sup> Nowadays, the marketing for Mexico City claims having more museums than other major global cities (roughly 170).<sup>2</sup> What's interesting is there are only around half a million visitors to museums each month in Mexico City, 93% of them Mexicans. This represents 0.1% of Mexico City's population and 0.6% of the country's population.<sup>3</sup> Museums in the city have changed their role over time but not in the same way they have evolved around the world. My hypothesis is that the slow pace at which museums are updated, remodelled, improved and redesigned, has decreased the willingness of the public to visit these spaces.

The Iberomuseos -Iberoamerican Initiative comprehends museums as "dynamic, live institutions that allow intercultural change, as places that work with memory power, as relevant instances for the development of educational and formative functions, as adequate tools that stimulate

---

<sup>1</sup> "Museo de Historia Natural - El Museo en el Bosque de ... - Sedema." Accessed January 20, 2018. <http://data.sedema.cdmx.gob.mx/museodehistorianatural/index.php/quienes-somos/mas-sobre-el-museo-de-historia-natural/mas-sobre-el-museo-de-historia-natural-y-cultura-ambiental-chapultepec>.

<sup>2</sup> "¿Cuánto cuesta visitar los museos de la CDMX? - El Universal." Accessed December 29, 2018. <https://www.eluniversal.com.mx/destinos/cuanto-cuesta-visitar-los-museos-de-la-cdmx>.

<sup>3</sup> "Estadística de Visitantes." Accessed February 3, 2018. <https://www.estadisticas.inah.gob.mx/>.

respect for cultural and natural diversity and value the bonds of social cohesion of Ibero-american communities and their relationship with the environment".<sup>4</sup>

There are not many studies nor measurement tools in Mexico that explore the true meaning of museums for Mexicans today. The few studies found published only include a very low percentage of the existing museums in Mexico and they do not look into qualitative information about their value and purpose, making it hard to develop hypothesis around the impact of museums in the country.

The latest study found is a CONACULTA study done in 2010 that shows quantitative results around the top 15 museums in the city analysing the amount of visits they receive annually, the reasons for visiting, the type of visitors, people's preferences, etc. This study interestingly shows the top motivation for Mexicans to visit a museum with a 27.2% of responses is to do homework or because they are sent by their school; 7% of them responded they go so that children will learn. Other top reasons are entertainment, enjoy a temporary exhibition, to know the place and to accompany a family member or friend.<sup>5</sup> It is important to mention that this study was developed with surveys that contained predetermined answers for people to select, meaning the participants were limited to respond the way the survey asked to.

On the other hand, many of the largest and iconic museums in Mexico are managed by the government and therefore, do not receive economic support to carry out improvements or new projects. In Mexico, the government tends to struggle, budget-wise, with large projects that require planning because there is much change in-between the six-year periods that a political party lasts. Once a new president is elected, there isn't a habit of making long-term plans, since

---

<sup>4</sup> "iniciativa iberoamericana - ibermuseos - Segib." November 5-7, 2007. <https://segib.org/wp-content/uploads/INICIATIVA%20IBERMUSEOS%20.pdf>.

<sup>5</sup> "Estudio de visitantes a museos 2010 - sic.gob.mx." December, 2011. [https://sic.gob.mx/estudios\\_publico/17.pdf](https://sic.gob.mx/estudios_publico/17.pdf).

during the following six years, a new administration often change all projects again. During the last decree in 2016, Mexico City's government administration confirmed only 3.5 million pesos would be destined for the city's public museums, and, without any justification, 78.6 million pesos would be destined for one private museum called Papalote Museo del Niño - an interactive children's museum owned by the three largest monopolies in the country.<sup>6</sup> It is never news that the oldest museums do not receive enhanced budgets, and that is the reason for their uncared-for appearance and lack of infrastructure.

### The Museum of Natural History and Environmental Culture in Mexico City

The opening of the Natural History Museum on October 24, 1964 lead into the 1970s museum building boom. It was located on the second section of the Chapultepec Forest with the purpose of stimulating, documenting and spreading activities that promote knowledge about the Universe, the Earth and life to its visitors.<sup>7</sup>

Besides a small administrative change, the museum hasn't been updated since it first opened its doors and neither has its purpose statement. It is located in a vast urban park, including 7500 sq. m. of exhibition spaces within 10 vaulted environments, each representing a different theme and collection.

---

<sup>6</sup> "del Presupuesto de Egresos." Accessed January 18, 2018.

<http://www.iedf.org.mx/transparencia/art.14/14.f.01/marco.legal/DecretoPresupuesto2016.pdf>.

<sup>7</sup> "Museo de Historia Natural - El Museo en el Bosque de ... - Sedema." Accessed January 20, 2018.

<http://data.sedema.cdmx.gob.mx/museodehistorianatural/index.php/quienes-somos/mas-sobre-el-museo-de-historia-natural/mas-sobre-el-museo-de-historia-natural-y-cultura-ambiental-chapultepec>.



Figure 1. The MNHEC 1964



Figure 2. The MNHEC 2018

<http://data.sedema.cdmx.gob.mx/museodehistorianatural/index.php/quienes-somos/mas-sobre-el-museo-de-historia-natural/mas-sobre-el-museo-de-historia-natural-y-cultura-ambiental-chapultepec>

In contrast with other museums in the city, the MNHEC is mostly visited for nostalgic reasons. Employees at the museum suggest it is special because when it was opened, for several years it was visited by many schools, and today those children- now adults- return to refresh their childhood memories and to take their children.<sup>8</sup> This suggestion can be supported with the CONACULTA 2010 study, where responses tell us the MNHEC is the only museum that is visited because “they have known it since always/since they were kids” (20.7% of responses); 34.5% of the visitors of this particular museum go for academic reasons, and only 11% go to learn or take their children to learn. On the other hand it is ranked 8th, amongst the top 15 preferred museums in the city. But as much affection visitors may have for this space, it is the worst ranked for its installations assessment and more than half of its visitors agree they would like to change something about the museum’s facilities, locating the MNHEC second on that list versus its competitors.<sup>9</sup>

<sup>8</sup> Mercedes Jiménez del Arco, interview by author, Museo de Historia Natural, Mexico City, December 6, 2017.

<sup>9</sup> "Estudio de visitantes a museos 2010 - sic.gob.mx." December, 2011.  
[https://sic.gob.mx/estudios\\_publico/17.pdf](https://sic.gob.mx/estudios_publico/17.pdf).

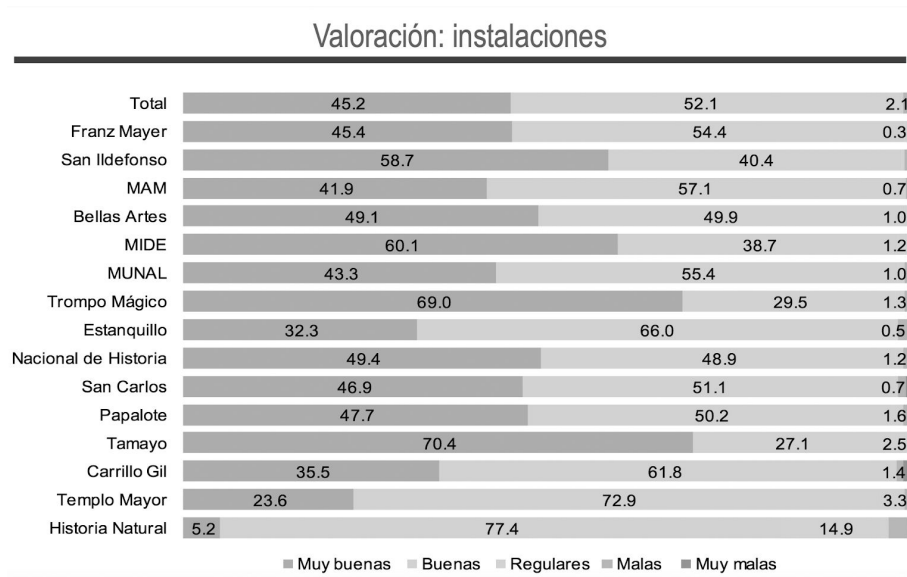


Figure 3. Facilities Assessment of main museums in Mexico City  
[https://sic.gob.mx/estudios\\_publico/17.pdf](https://sic.gob.mx/estudios_publico/17.pdf)

After being open for more than 50 years, the museum was partially renovated for March 2018, as three of the vaults were redesigned by Sietecolores, Ideas Interactivas, an innovative local exhibition design firm.<sup>10</sup> The goal is to renovate the whole museum, but due to fiscal restraints, the process will go vault by vault, continuing on until there is a change in governmental policy. Through this renovation the museum's administration hoped the new vaults would impact and improve the number of visitors that visit, and the learning experiences it offers.

As a brief for my MRP I hoped to explore if the new vaults could represent a little step towards becoming a more inclusive museum.

### Inclusion and education in museums world trends

Today, museums are undertaking with much seriousness the demand to be more inclusive, and many of them make several efforts to make sure the future has important changes on the

<sup>10</sup> "Sietecolores | Conceptualización y desarrollo integral de espacios ...." Accessed January 13, 2018. <http://sietecolores.mx/>.

matter. In this section I will explain some of the examples I found around museums taking on inclusion initiatives.

The American Association of Museums has made attempts to study demographics about their museums' visitors, because they recognise population is changing, and they need to build a more inclusive future for museums if they want to increase the number of visitors and attract minority groups. Some successful cases have changed their marketing strategies, some their staff, some their exhibitions and activities, others have even changed their interior design and architecture to connect with more diverse populations.<sup>11</sup>

The Museum of Science in Boston uses a Universal Design approach reflected on its framework for inclusion, laid out in the Center for Advancement of Informal Science Education (CAISE), Inclusion, Disabilities, and Informal Science Learning report. This framework emphasises the physical, cognitive, and social inclusion of visitors with disabilities in museum experiences. They have a specific section in their website where they explain their approach and publish their annual plans to implement new practices. As they state on their website:

*"Using a universal design approach in museum education ensures that experiences are designed with inclusion in mind. Visitors with disabilities should be considered a part of the core audience, and educational opportunities should be developed so that people with a wide range of abilities and disabilities can interact without relying on specialized devices or other members of their group.*

*We are constantly revising and improving our approach based on feedback from*

---

<sup>11</sup> "Demographic Transformation and the Future of Museums - American ...." Accessed December 2, 2017. <https://www.aam-us.org/wp-content/uploads/2017/12/Demographic-Change-and-the-Future-of-Museums.pdf>.



people with disabilities, research and practice at other organizations, and technological advances.”<sup>12</sup>

According to the article *How can we make museums more inclusive?* from The Inluseum,<sup>13</sup> the most common way for museums to engage with children with Autism Spectrum Disorders appears to be through separate, disability-specific, programs. This article talks about examples in various museums, one of them is The Metropolitan Museum of Art offering special workshops for children that claim to be multi-sensory because they carry out activities where children and families can create art with tactile elements. Another example mentioned in the article from The Inluseum is the Children’s Museum of Chicago as an example of a space that searches to welcome all visitors by making its facilities, services and programs accessible. The museum provides kits for visitors to navigate, developed with The Autism Program of Illinois, storybooks for children with disabilities, maps indicating noisy areas for visitors to be informed and able to avoid certain areas, and sound reducing headphones. The Children’s Museum in Chicago also carries out training for the staff around assistance for people with disabilities. England’s Museums Association conducted a research project during 2015-16 titled “Valuing Diversity: The Case for Inclusive Museums”. The publication captures voices and perspectives from across the museum sector and beyond on the subject of diversity in museums and it encompasses insights from England, Scotland and Wales perspectives. It presents four successful case studies that show how an inclusive exhibition design changed a museum’s image and perception, as well as recommended pathways of action towards inclusive practices

---

<sup>12</sup> "Universal Design for Museum Learning Experiences | Museum of ...." Accessed January 20, 2018. <https://www.mos.org/UniversalDesign>.

<sup>13</sup> "The Inluseum: How Can We Make Museums More ... - Think Inclusive." December 6, 2015. <https://www.thinkinlusive.us/inluseum-inclusive-museum/>.

in museums.<sup>14</sup> What they've accomplished with this project is the creation of a strong community of practice that promotes inclusion principles and tools in museums, so far, for England, Scotland and Wales.

The Art Gallery of Ontario (AGO) in Toronto has worked with OCAD Inclusive Design program over the past couple of years and they have designed an inclusivity cart used by specialized staff as a tool to aid special inclusive tours. The cart contains a series of objects that help translate some of the artworks to multisensorial mediums so that visitors may access the artworks in different ways. The AGO also holds tactile tours allowing visitors to touch some of the artworks, especially sculptures.<sup>15</sup>



Figure. 4. AGO Inclusivity cart

Photo: Alejandra Bortoni

---

<sup>14</sup> "The Case for Inclusive Museums - Museums Association." Accessed December 4, 2017. <https://www.museumsassociation.org/download?id=1194934>.

<sup>15</sup> "Access to Art Group Visits | Art Gallery of Ontario." Accessed December 28, 2018. <https://ago.ca/group-visits/access-art-group-visits>.

The Antiguo Colegio de San Ildefonso in Mexico City, a local art museum, has recently kicked off a program with university students where they are developing tactile representations of some of the artworks and murals in the museum, and they are also giving special training to the staff so they know how to give inclusive tours for blind visitors.



Figure 5. Tactile representations at Antiguo Colegio de San Ildefonso

Photo: Alejandra Bortoni

The Museum of Tomorrow in Rio de Janeiro was built accessible from the start<sup>16</sup>. They worked hard to cover the basic accessibility aspects and construct their exhibitions and hallways in a way people with disabilities can visit without special help, find their way and access the content of each section. They have interesting ideas regarding tactility in their exhibits, maps and multimedia materials. I will be including some references to these later in this document.

There are a vast number of cases that reflect inclusion practices all over the world and many of them refer to new interaction designs. Researches and authors in the field are working on new models specifically for museums, in order for them to work towards an envisioned inclusive future. Throughout this document I will expand on some examples that lead me to this finding.

---

<sup>16</sup> "Accessibility at the Museum of Tomorrow - Blue Trunk Foundation." Accessed March 2, 2019. <https://bluetrunk.org/accessibility-at-the-museum-of-tomorrow/>.

## Chapter three

### Exploration

#### Stakeholders interviews

During the first two phases of my research I had interviews with key leaders of the museum in order to understand firstly about the museum before it's remodeling, and to understand secondly, where it stands in terms of inclusion and what the remodeled exhibitions impact was.

I spoke with: Mercedes Jiménez del Arco, Principal Director of the museum; Alejandro Camarena, Director of the department of Education; Liliana Montañez, main Curator of the Temporary Exhibitions; and Leonardo Arturo Viguri, in charge of conservation. I also had a chance to attend a meeting that all the team had with a representative of the design firm that remodeled the new vaults, Siete Colores, where they talked about accessibility matters.

What I learned from these interviews helped me develop a more approachable understanding of the museum and make further decisions with the adequate scope for my project.

Mercedes Jiménez del Arco's main concern is to keep the emotional link the museum holds with its visitors' childhood memories. Over her years of leadership she has come to understand that Mexican visitors come to these galleries to recall their childhood experiences and reconnect with that nostalgic feeling. She believes the museum holds history of its own that needs to be preserved. She is constantly moved when visitors come back and thank the museum for helping them find their dream careers in science, astronomy, or history, acknowledging the museum for their professional calling.

During my interview with the department of Education's Director, Alejandro Camarena, I learned that even as a public institution, there is a lack of oversight from the government, nor a clear set of key performance indicators (KPIs) but rather just gathering attendance data. This means the activities, workshops, performances and content of each exhibition, are all designed based on intuition and with the best of intentions to offer good experiences; this finding comes from several interviews with the Education Department. Nevertheless, they have never performed studies about the museum's impact on people, neither at an educational level, an entertainment level or an engagement level. They know they are in need for such a study, but they don't have enough resources to hire a specialized company to do it. All they know is how many visitors enter the museum each day, how many participate in the activities and what sorts of comments are left on the guest book and the teachers' questionnaires for school groups.

Alejandro also talked about the museum's awareness, the museum doesn't have resources to have a strong broadcasting reach and it isn't located in a strategic area. Many museums in Mexico City were built in concentrated areas where tourists commonly walk by, but this museum is hidden in the second section of the Chapultepec Forest where people go either to the attractions fair, to the Papalote Museo del Niño- a children's museum, or to exercise. Public transportation doesn't pass through this museum's entrance either, so the people who come to the MNHEC, should have had to plan to go intentionally.

Regarding the remodelling project, all of the interviewed stakeholders showed some concern about how it all came around. As much as they could participate in the process and give their advice, they are all aware it was an external and modern perspective leaving at risk the preservation they have always fought to keep: "that sensation of entering the past and

remembering childhood”, as one of them described it. They did their best to work along with the external company, and hope it will bring more visitors to the museum and increase engagement. A few weeks after inauguration it already was attracting thousands of visitors to discover the new vaults, and the staff were well aware it would have a strong visual impact in visitors before the inauguration happened.

Alejandro showed excitement for this new era because he has a long career in museums and cultural institutions in the country and knows this museum stayed as an antique for more than fifty years. He believes the remodeling means going from contemplative experiences to interactive experiences. From the old classic history museums where people could only stare at the objects, to a dynamic museum where people can interact in different ways with its content.

In terms of inclusion, during these first interviews we only discussed diversity at an educational level so they all showed interest in broadening their audience to people who didn't know much about nature and people with diverse education and literacy levels. This museum is a strong ally of elementary and secondary schools, and it tries to keep this alliance by putting much effort in performing educational activities during school visits and translating the content in a more friendly way so that children may understand. The education team has a clear objective: to awaken interest in the natural sciences by surprising and entertaining. But they take in the responsibility to go beyond offering good experiences and contribute actively in the country's education and its citizens development.

Liliana and Leonardo, in charge of conservation, both explained they are more focused on the collection than on the visitors experience. They are the experts around what the pieces the

museum owns mean to history and to nature. The curator gave me a thorough explanation of how they create an exhibition and the differences between a temporary and a permanent exhibition. She has created most of the temporary exhibitions from scratch. The conservation expert on the other hand, is very strict about the conditions the objects need to be in and the importance of the collections the museum owns. Based on the behavior she has observed from the visitors, she believes the public does not have an awareness of how valuable the collection is and therefore strict precautions must be taken when choosing the objects for the setup of a new exhibition and large efforts must be put in when creating the conductive thread that will allow visitors to understand the discourse, hence value the collection. They both believe this museum's goal has been and still is to generate calling on natural history vocations, because by showing there are still gaps and a lot to be discovered, they believe they make an open invitation to people to join the journey of discovering more and developing new research.

As for the new exhibitions, their opinion is they cause admiration and surprise, but they lack resonance, meaning they are at risk of not leaving any informative marks in visitors when they leave. How the museum's creators wish to impact the public is still faint, some mention education, others mention vocation, reflection, information, enjoyable experience, each stakeholder holds a different perspective.

Another relevant touchpoint I had with the museum stakeholders was a meeting they invited me to join post the opening of the new exhibition vaults. During this meeting they talked with a representant from Siete Colores about the accessibility initiatives the museum had up to date. They mentioned the museum is part of the Museums Network for the Attention towards People

with Disabilities in Mexico City,<sup>17</sup> but this has only meant that a couple of years ago they received basic training for the staff around accessibility; no other value has been identified for belonging to this organization. They also mentioned they have a deaf tour guide who has given special tours to deaf visitors, and they talked about an activity they held years ago where they let blind visitors touch part of the collection that wasn't exhibited for the general public.

Regarding the team from Siete Colores that was in charge of the remodeling work for the new four vaults, I tried to reach them since the beginning of the project with the Director's help, but for unknown reasons, they have postponed our conversation for a year and I was never able to interview them.

The stakeholders interviews I performed helped me have a stable basic starting point for my research and understand the current position of the MNHEC from a back-end's perspective. All of the interviewees spoke about their audience showing confidence they know very well what type of visitors come to the museum: children coming in school groups, families, couples and elderly people.

## Observations

I was allowed to enter the museum for free, to observe and take notes during its regular visiting hours. Each observation lasted from three to five hours depending on the attendance numbers. I went during week working days and focused on the school visit tours that covered all of the museum: old and new vaults as well as education area's activities. Additionally I went to the once-a month night of museums visit open to all public.

---

<sup>17</sup> "Red de Museos - indepedi - CDMX." Accessed February 2, 2018. <http://data.indepedi.cdmx.gob.mx/museos.html>.



During the weekends I dedicated full days to each section: main entrance area, temporary exhibitions, old permanent exhibitions, and, once opened, the remodeled permanent exhibitions. For each section I dedicated two days of observation, one week-day and one weekend day, and the observation lasted from four to six continuous hours. During the observations I documented how many people walked through that section, the visitor's characteristics and what interactions took place: I observed how they behaved, where they spent more time, what they engaged most with, how they interacted with other people, how they interacted with the space and how they interacted with the exhibits. In addition I made observations of the education department's most regular activities: they organize games, tours, theatre performances, among others; during these I observed how people behaved, what interactions took place as well as the characteristics of the people engaging in these activities.

The most interesting findings I had during this phase were around the new vaults exhibition design. I am not an expert on museography, but as a visitor and designer it was easy to realize that the content is very hard to encompass. It might have been done on purpose, but I found four main reasons why it represents a problem:

- The first is content overload: from the moment a person enters there is too much information everywhere, the space is packed with attractive elements. Animals, dioramas, titles and text in different sizes, images, paintings, screens, sounds; it is all thrown to visitors causing an overwhelming sensation and causing uncertainty as to where to start. Visitors are forced to go after whatever called up their attention the most and start from there, hence people leave a lot of interesting information out. It is almost impossible for someone to encompass so much in a few hours, and children get anxious

and tired after seeing a few animals and playing a single game. This content overload situation is then affected by the second reason.

- The second reason is the unbalanced distribution of space: some sections with introductory information are very tight in space so large crowds are stuck and don't allow more people to walk. This effect forces people to move along constantly and give up on reading the complete texts. People rather move over to where they are more comfortable and at some point prefer to go around the exhibition looking only superficially to the larger objects and leaving without further engagement.

Tour guides represent help with both of these situations because when there are large crowds they constantly ask out loud if someone wants to learn about a subject and direct large groups towards an object where they start telling a story so that people can understand the content and follow a thread.

- The third reason is visibility of the information and objects: many pictures, shapes, graphs and texts are set at 3 to 4 meters above the ground. Most people cannot read this information so they often skip these sections. Other sections have very small typography so it is also difficult for people to read it.
- The fourth reason is the inconsistency of language: there doesn't seem to be any logic behind the way text is designed. Some sections have brief texts with large fonts using a friendly simple language. Others appear with very long texts, tiny fonts, but also friendly understandable language. A third category has long or short texts but using a complex

academic language that is very hard to understand. It was easy to spot these categories and see people's reactions to each section. Very few people make an effort to read long texts, but the visitors seldom stay engaged with long texts that use complex language. If the museum was talking to people, it would be difficult to describe its voice. I believe this to be a problem, especially since the museum has a lot of children visiting who, most of the time, don't understand complex language. In addition, it can also be taken into consideration the fact that literacy levels in a high proportion of visitors is inadequate to understand complicated writing.

The old exhibition vaults do not present this problem, they have less content and clearer conductive threads. It might have to do with the fact that these other vaults are constructed in a linear way, whereas the new four vaults are all intersected into a large rounded space. Nevertheless, the old vaults have acoustical issues; a lot of echo is produced making it hard to hear during simultaneous tours or when children are screaming. This sound issue was successfully resolved in the new vaults.

Thorough observations allowed me to contrast what I saw happening at the museum everyday with the stakeholders points of view, and later connect the findings with the visitors' perspectives from the contextual interviews.

### **Contextual interviews**

This activity consisted in approaching visitors randomly at different stages in their visit and asking a few questions about their experience at the museum. I talked to 53 visitors during three different weekends as well as four teachers who took their school groups during

weekdays. I complemented these interviews by reading the comments notebook placed at the end of the route and reading through the comments left on the museum's Facebook page and Instagram account.

Most visitors take their children for either family entertainment or because their kids were given homework at school concerning the museum. Some kids ask their parents to take them because they want to work with animals or nature when they grow up, they would say this proudly.

More than half of the interviewees had visited this museum previously in the past and were returning to see the remodeling results. Some adults had not come back since they were young, and they kept asking about objects they had seen back then but couldn't find them anymore; they appeared to want to remember and revive their experience.

Interestingly enough, the visitors I asked about their favorite part, who hadn't entered the new vaults yet, talked about some parts of the old exhibitions with excitement and were able to describe what they learned from those parts. Two sections from the old vaults were referred to the most in this case: the human evolution section and the human body vs. animals.

For both sections visitors were able to tell me what they learned from them easily, for example, they would explain all the characteristics of humans that have evolved throughout history and even name the different human species that existed before us.

On the other hand, when asked about their favourite part, visitors who had gone through the new vaults talked about the objects that made the most impression on them, but couldn't talk about what they learned from them. The dinosaur was one of the favorites, causing amazement

because of its huge size. The underground coral reef, surprised visitors because of its colors and fun way to look at the animals beneath their feet, most visitors took selfies by laying on the ground to have the sea coral-reef diorama on the background. Other animals were mentioned as well: like the seals, giant turtle and bear.

Visitors who came out of the new vaults were highly impressed about the remodeling work, congratulating the museum for having such modern exhibitions and acknowledging its attraction to the scenery design: light effects, colors, painted walls, vast varieties of animals, highly detailed dioramas, sounds, interactive screens, among other details.

I was able to talk to five visitors who were on wheelchairs on two different days. I asked them about their experience and at the end of the conversation I asked them about any accessibility issues they might have had. Most of them were pleased with the museum and the fact that they could access the spaces thanks to the ramps. Two of them were male adults visiting by themselves and wheeled their chairs unaided. One mentioned the entrance ramps were wrongly constructed and therefore it was very rough to enter, the ramps have a steep incline and he had to try several times using all his arm strength to make it. He knew the ramps were only there to comply with regulations but they probably weren't to a regulated standard.

The other man talked about another ramp outside that was difficult to climb, and that it had a slippery metal handrail, making his chair move backwards, eventually forcing him to put one of his legs on the ground to support his body weight.

Another two visitors mentioned almost everything was great, but some exhibits had objects set too high with the information making it impossible for them to see properly or read the

descriptions. This applied to some interactive activities as well where they couldn't reach the buttons. My own observations informed me that little children had this issue as well.

One lady who was accompanied by two nurses mentioned one of the tour-guides voice was so loud and high pitched she had to leave the presentation. She was annoyed and told me it was unprofessional to talk that way because not all visitors were children.

In general, what the stakeholders told me about the museum and its visitors was confirmed through these interviews, but what I realized was that the remodelled vaults were worth evaluating further in terms of quality content and educational effectiveness, particularly if the museum's mission statement isn't to entertain but is meant to spread knowledge about nature and Mexico's history.

### **Staff interviews**

After the contextual interviews, I was given permission to talk to the staff: the education team that was composed of the tour guides, the people at the tickets station, the security guards and the cleaning staff. I asked them about their job, their role and responsibilities, what they liked the most and what they disliked. Towards the end I asked them about their thoughts on inclusion, whether they've had encounters with visitors with disabilities, and how they approached these situations.

What I found out when talking to employees at the ticket booths is that a large percentage of visitors come from outside Mexico City. They know this because the ticket booth represents the first interaction with visitors, hence they feel responsible to set the tone. They chat with people

to give a nice warm welcome and to find out where visitors come from, their purpose for visiting the museum and any first-hand questions. They attribute the questions people ask to the lack of information on the internet page and social media. They know these communications assets are rarely updated so people mistakenly come in on the wrong schedule or during closed-sections periods, therefore they can't access areas that are being remodeled. They know the temporary exhibitions and recently opened sections attract more visitors, and on weekends, the museum is well attended, so they are extremely busy.

These employees love their job, they maintain it is fulfilling to talk to people and joke around; they like the good vibes most visitors bring. They do not like when people have negative attitudes and want to bend the rules, for example entering or leaving later than permitted. They sometimes get frustrated by the unwillingness of people to read the signs because they all ask the same questions even though there are signs around the museum with most answers. They understand some people are tired but they can't find justification for people who are rude to them. They are also in charge of generating attendance reports but they are aware they do not count the visitors who have free entrance, for example visitors with a disability or elderly people. They are not sure why people with disabilities don't have to pay to get in, but they all assume it has to do with the museum being owned by the government. They believe they are able to give special attention more easily during weekdays when the lines aren't so busy. During these weekdays they try to accommodate for people with disabilities, for example, they call the hearing impaired staff member who gives signed tours to help deaf visitors, they lend wheelchairs when needed (they only have three available) or they offer an attendant to accompany a visitor who needs special help. They have learned throughout the years that some

children who come have autism or other intellectual disabilities so they are no longer surprised by unusual behaviors.

The security guards hold similar perspectives, they like to have a lot of people come into the museum so that there is movement and challenges to resolve, when it isn't busy they get bored. The guards don't like it when people are rude or get upset but they know it's part of their job to stay calm and always be polite. They work 24 hours shifts -working for 24 hours and then resting for 24 hours. None of the guards speak English or other languages so they find it difficult to welcome foreign visitors. They have asked the hearing impaired guide to teach them basic signs to welcome deaf guests. One of them has a daughter with a disability so he feels more comfortable around visitors with disabilities. All of them expressed they have seen discrimination happen among the visitors, for example, one of the guards told me about an event in which two family parents complained about a visitor in a wheelchair with an intellectual disability that was "scaring" their children, he also mentioned children tend to make fun of visitors with disabilities or simply stare at them awkwardly. On the other hand, they explained that the museum has never shown discrimination to visitors and that they hold the responsibility of offering special services to visitors who might need them. They are also tasked with counting how many visitors enter, besides the tickets, they use a device to count the entrances. The guards also mentioned that people frequently ask if they are in the right place, because it is so difficult to get to this museum, and because often they are confused with the National History Museum that is located in the first section of the Chapultepec Forest (five kilometers away).



The education team all expressed similar values. They are very passionate about their profession- they are biologists in a natural history and environmental culture museum. And the team feels proud and responsible for the education of children and families about concepts pertaining to nature and its origins. They are the most creative and proactive collaborators in the museum because they use what little resources they have to create new experiences for the visitors. They have installed a small theatre where they wear costumes and perform made-up stories so that children may understand the content better. And they are always willing to help and answer people's questions even if they are not related to the museum's content.

Most of them have worked at the museum for more than three years and have developed their own style to address subjects and teach during tours. It was thanks to these interviews that I found more out about attendance of visitors with disabilities. They talked about school groups containing children with cognitive issues and autism. They seemed to be comfortable with this because it has happened enough times that they have learned through the teachers or parents how to approach them.

They explained about the hearing impaired tour guide in their team who has taught them sign language, and gives tours to deaf visitors himself. They said it is difficult to identify deaf visitors because they seldom ask for special treatment, and there is a lack of information about this service posted anywhere in the museum or on its website or social media.

One tour guide told me about an experience she had giving a special tour to a large group of imprisoned men and how she was surprised by their exceptional engagement and attention to detail during the tour. She was moved when some of these men told her they had never seen most of the animals exhibited before.

These interviews and my own experience have formed in me the opinion that Mexico lacks an inclusive culture that accepts and understands disability in general, so it wasn't a surprise that the museum has no real training initiatives for its staff in regards to visitors with disabilities.

My perception of the museum is that the staff plays a key role in setting its welcoming atmosphere. Everyday there is a calm, pleasant air breathed in the museum and people seem to be happy all the time. I acknowledge this enjoyable experience to the staff, because it is evident that they are always friendly and kind to visitors, with authentic smiles on their faces. Everyone I spoke to expressed true fondness for their job and most of them had stayed there for many years because of the meaning it gives to their lives.

The Stakeholders interviews, Observations, Contextual interviews and Staff interviews all informed the insights that lead my research process. The different perspectives helped me find patterns and conclude on where the main barriers for inclusion are and the interactions that could become opportunities for improving the visitors experience.

Besides the in-depth research developed at the MNHEC I decided to speak to stakeholders from other museums in Mexico to find out more about the field of practice in the city.

### Other perspectives

In order to understand the broader context of inclusion for museums in Mexico I did some desktop research that lead me to find Paloma Oliveira, who worked on an inclusion project for the Alameda Digital Lab, a contemporary digital art museum in Mexico City.<sup>18</sup> Paloma agreed to meet me and she showed me all the work she has done for the museum as the Director of

---

<sup>18</sup> "Lectures about Museography and Accessibility - Tecnologias e afetos." Accessed November 28, 2017. <http://www.discombobulate.me/en/workshop/inclusao/>.

curation and museology. She requires the artists who want to exhibit in the Lab to think of multisensorial interpretations of their work, guiding them to solve for diversity, for example, if an artist wants to exhibit a cube filled with water so that people can play with the water and look at the light effects, she encourages the artist to add sound as the visitors move their hand in the water so that visitors with sensory disabilities can address the work with other senses. She also asks potential artists to consider people in a wheelchair when determining the height and interactive access of their art work. A good example was Jaime Lobato's exhibition *Transmutation: Space Alchemies*, which Paloma Oliveira curated.<sup>19</sup>

She showed me the exhibited work as well as some architecture interventions she provided to make it more accessible. This museum is located inside a building that is an historic precinct of the City, therefore it doesn't allow for much architectural intervention due to historical conservation regulations, nevertheless, the director is doing her best to work around the problems and create solutions for inclusion. She also worked on a strategic roadmap for the museum that consisted of staff training, and searches for sponsorships and public workshops to promote inclusion. Her advice for working with public institutions was to refer the law, more specifically Mexico City's Law for the Integration to Development of People with Disability,<sup>20</sup> which states that all public spaces have to be accessible for anyone despite their disability, and holds specific accessibility measurements to be complied with.

Paloma's input was crucial for my research project because it inspired me and motivated me as proof that shows the road towards inclusion can be achieved.

---

<sup>19</sup> "Transmutation: Space Alchemies by Paloma Oliveira - issuu." August, 2017. [https://issuu.com/palomabase/docs/cuadernillo\\_jaime\\_ingles](https://issuu.com/palomabase/docs/cuadernillo_jaime_ingles).

<sup>20</sup> "Ley para la Integración al Desarrollo de las Personas con - Asamblea ...." Accessed February 3, 2019. <http://www.aldf.gob.mx/archivo-b28392e3c828c3108d8b0873830eb35d.pdf>.

## Chapter four

### Visitors' journey and fields of action

After having a deeper understanding of the museum, I realized there were different fields of action that I could impact at different levels.

The observations and interviews I'd done until this point helped me map the visitors journey to get a sense of all the areas where inclusivity changes could happen.

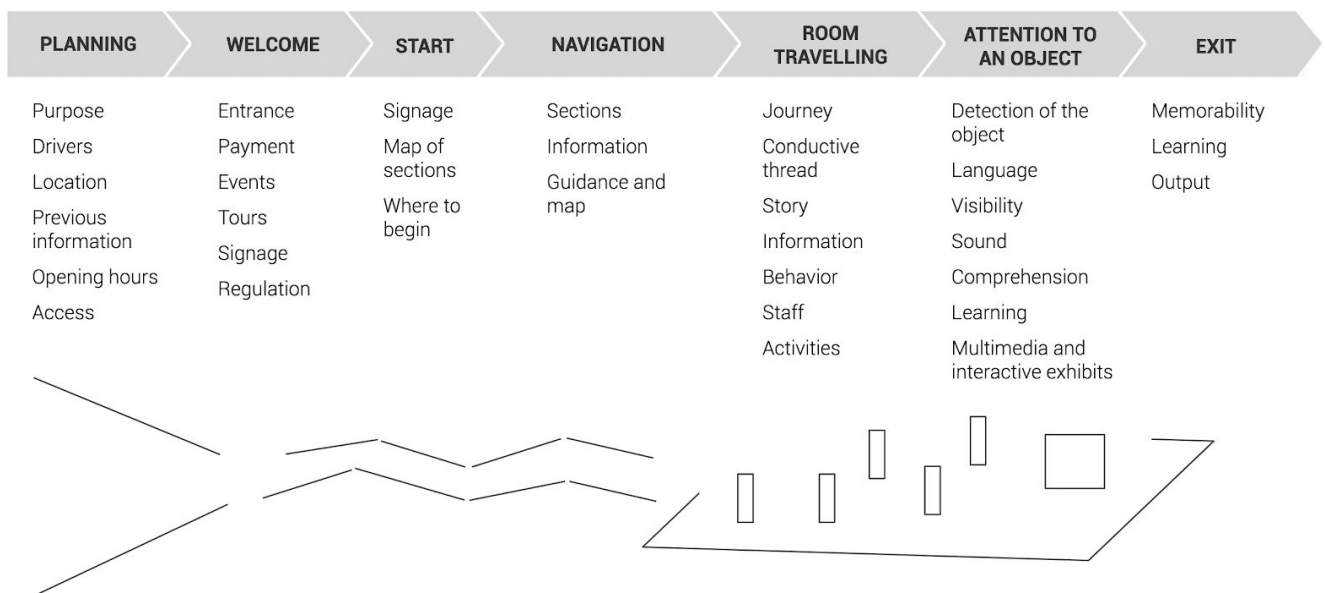


Figure 6. Visitors Journey Map at the MNHEC

These are the stages of the visitor's journey:

- PLANNING
- WELCOME
- START
- NAVIGATION
- ROOM TRAVELLING
- ATTENTION TO AN OBJECT
- EXIT

## PLANNING

The visitor's journey begins before getting to the museum at the stage called Planning and it is here where the experience really begins. At this stage all of the following fields have areas of improvement:

- **Purpose:** visitors have different purposes for attending a natural history museum,
  - a) some want to be entertained or their children entertained for a few hours
  - b) others need do their school homework
  - c) some might want to learn about natural history
  - d) others might only want to be surprised and discover new facts about their country.Whatever their purpose is, the museum faces a big challenge to comply with diverse motivations.
- **Drivers:** the goal of this museum isn't explained in a clear way, so people are not sure there is a reason to visit this museum because they don't know what can be found there. The museum doesn't have strong marketing efforts so it relies on elementary schools and recommendations to promote itself.

- **Location:** it isn't easy to get to the museum, it is hidden in the forest in an area with irregular transit and it is easily mistaken with the National History Museum.
- **Previous information:** the information posted on the webpage, Facebook and Instagram accounts is seldom updated. The webpage lacks detail and its information architecture isn't functional. Most visitors end up having to call to ask for information or are often disappointed once they get there, because they didn't know the opening hours, or because they didn't know a section isn't open to public temporarily. These issues can be annoying, presenting barriers for potential visitors.
- **Visiting hours:** the visiting hours only allow to access during regular work schedules and in such a busy city, it can be complicated to attend at those hours due to heavy traffic congestion.
- **Access:** there is no public transportation, a very small parking lot and it is surrounded by stairs, hills, bike rails and rocky pathways. Most visitors have to walk a long way to access the museum and it is challenging for people with mobility issues.

## WELCOME

As soon as the visitors arrive at the museum, the welcoming experience has the following needs of improvement:

- **Entrance:** the entrance has only one inappropriately constructed ramp for people who cannot use the stairs.
- **Payment:** the tickets sale area has many signs, overwhelming people so that many visitors frequently ask the guards or the ticket saleswomen about payment, hence this

phase takes too much time and long lines are formed at the entrance. Even though the entry fee is inexpensive, people with disabilities aren't always aware they are entitled to free access, so they line up, wasting their time doing so. An interesting finding was that people with disabilities sometimes complain about having free entrance because they conclude the museum is therefore not obligated to offer them the same experience that paying visitors enjoy; in other words, the museum is less obliged to be accessible for people with disabilities because it doesn't charge them, therefore it is perceived as a form of exclusion.

- **Tours:** default tours happen on the weekends at specific hours and are open to all visitors who wish to learn a specific subject. These consist of standard tours where a member of staff walks a group through some of the objects in the museum and teaches about a subject of interest. Booked tours are only for school-groups during weekdays and are adapted to the group's needs.
- **Events:** scheduled events are around temporary celebrations and happenings such as the visit of a natural-history celebrity, an important event of nature, or a temporary exhibition. Besides these spontaneous events, once a month the museum opens during the evenings and offers additional activities, conferences or concerts. All of these are usually announced on Facebook only.
- **Signage:** there are so many disparate signs in the welcoming space that it is overwhelming, which undermines their effectiveness to the point of confusion.

- **Rules:** the rules for the museum are also printed out on a poster and are often skipped by visitors. They are standard rules regarding restrictions about food or drinks, drugs, smoking, running and noise.

## START

Once the visitors are set to begin, different areas influence their experience:

- **Signage:** the architecture of the space doesn't provide visitors with an intuitive sense of navigation, all visitors often ask museum staff where to go to begin their journey, where they can find the bathrooms, the lockers, etc.. The vaults have posters at each entrance which do not provide information about what each vault contains and how they are interconnected.
- **Map of sections:** there is a printed map at the entrance that most visitors skip because it's not very well designed: It is difficult to understand because it doesn't use information hierarchy and it doesn't explain what can be found where. Visitors depend on the guards or staff members to find their way around.

## NAVIGATION

This stage encompasses the influencers around how the visitors move through the museum and get to where they want to go, from one place to another:

- **Sections:** some sections combine different subjects, it isn't very clear where to find what. Visitors often ask for very specific objects irrespective of what the story of an exhibition area is. The vaults are constructed in a way they can be entered through



different doors; the atrium at the center is not well connected to each vault, forcing people to go around pathways until they find the entrance they are looking for.

- **Information:** there is a lack of overview information about each area of the museum, for example there isn't an introduction at the beginning of each section so the purpose of each vault isn't explained; and many times the titles and names of areas do not use consistent language.
- **Distribution:** there isn't a clear distribution of the exhibitions, it seems to be a random selection of the vaults for different exhibition areas. Each vaulted exhibition has a different subject, some exhibitions are bounded together so visitors walk in continuation from one to another, but there doesn't seem to be a correlation between the subjects and the space each occupies.
- **Guidance and map:** there is no map for the museum except the large poster at the entrance hall. There is a small metal engraved map that is out of date and difficult to find. There aren't any portable printed maps for visitors.

## ROOM TRAVELLING

At the moment visitors arrive at an exhibition section, or vault, their movement has different levels of impact as well:

- **Journey:** some vaults are designed in a way there is a clear path to go through the room as many museums work. But the four vaults exhibition is just a wide room with no clear divisions or pathways so the path to navigate the exhibition isn't clear.

- **Conductive thread:** the permanent exhibitions lack a conductive thread; it isn't clear why objects are where they are because the connections to a story don't exist.
- **Story:** the four vaults contain three main sections but I only learned this after several visits and desktop research. The exhibition design doesn't help to tell a story in a clear linear way.
- **Information:** the information for each section of the room is placed randomly and there is content overload. There isn't an introduction to each section so it is difficult to comprehend the messages. There are random phrases printed on the walls with a very large font but it isn't clear how they connect to the objects.
- **Behaviour:** the rules for the new exhibition vaults are announced to tour visitors by a member of the staff before entering the room. The rules involve not running or screaming, and touching only if it is signed. Most visitors are families with children who want to touch everything, run around and are often screaming.
- **Staff:** there are always at least four members of the staff at the new exhibition vaults for assistance, answering questions, facilitating activities, but mostly taking care that people don't touch the objects and lean on the displays.
- **Activities:** there is a designated area for activities such as games and quizzes which happen when a staff member is there to facilitate them because they are trained to use supporting material. There is also a special section called Biolab where every hour (weekends only) there is a presentation where a staff member shows real life elements and explains a subject in more detail. This area doesn't isolate the sound so when

visitors are seated at the back, they can barely hear the guide speaking because of the noise in the room.

## ATTENTION TO AN OBJECT

This is the stage where visitors stop at one of the objects and interact with it as part of their journey throughout the exhibition:

- **Detection of the object:** this is related to the content overload problem, there are so many attractive exhibits in the space that visitors end up going only to a few they randomly choose and miss out on a lot of interesting areas.
- **Language:** as I mentioned earlier in this paper, there is inconsistency in the language the museum uses at the exhibits some objects had long descriptions with academic language while others presented short descriptions with simple understandable language directed to children.
- **Visibility:** as I mentioned earlier in this paper, there is a lack of visibility of some exhibits as well as the support information.
- **Sound:** the old vaults presented sound echo problems due to the concave shape of the roof. This echo issue has been fixed in the new exhibition vaults; but it is now part of the content overload because the exhibits that use sound present problems for visitors to recognize how each sound relates to an object. Some video exhibits have very low sound that is hard to discern.

- **Comprehension:** along with the language inconsistency problem, the narrative of each object and section varies in a way that is difficult for all visitors to understand. This was detected in the tours as well, the guides do their best, but it isn't always easy to hear.
- **Learning:** there currently isn't a way to measure the learning outcomes.
- **Multimedia and interactive exhibits:** the few interactive exhibits are not as engaging as they could be. Some contain buttons, screens and sounds, but they often take a long time to load showing animated texts and images that don't necessarily factor into the intended learning experience.

## EXIT

As soon as the visitors end their visit, there are other levels of impact that could be improved:

- **Memorability:** Currently the museum doesn't know what people remember after their visit, but the few people I talked to referred only to shapes and sizes of some objects rather than interesting facts.
- **Learning:** Again, currently we don't know if people learned something from their visit, but my hypothesis is the content overload and language inconsistency makes it difficult for people to learn. Instead, they are entertained and surprised, with the exception of the school groups who are given specialized teaching tours.
- **Output:** today, there isn't information of the museum's experience output. What are the visitor's takeaways?; how do people feel after their visit?; what is the real overall value of their visit?.

All of these stages represent fields of action- meaning design could be introduced in an attempt to solve problems for all of them, which could impact the visitors' experience. If the intention is to help the museum be more inclusive, exclusion and pain points were found at all stages and at all levels. Hence, there could be many design solutions to all of the stages and levels that could improve visitors' experience and direct the museum to better inclusive practices. However within the project's timeline and scope, I needed to define the extent of my research so that viable solutions could be attempted and so that the solutions could cause true change and impact with an inclusive design perspective.

Before deciding which stage I would work with, I needed to choose a group of people I would co-design with to gain a deeper understanding of their specific experiences when they visit the museum. My intent was to have the group decide with me which stage we should work on, under the criteria that it would be the stage that could impact their experience the most in the long run.

### **Sample selection and redefinition of research question**

Given that the Inclusive Design Program encourages students to explore how current excluded individuals could be included in a certain field, I challenged myself as a researcher to choose a specific population group that I could work with to find solutions for inclusion in the museum. My decision was heavily informed by everything that I'd learned until this point about the museum, from its stakeholders and from the contextual interviews; and about disability, from the courses I was taking that involved reading about different disabilities as well as in-person tours to facilities, institutions and hospitals that aimed to help us students understand more about specific disabilities.

I decided not to work on the subject of learning effectiveness of the museum for two reasons: the first was that I am not an expert on pedagogical matters and it would have taken me too long to learn the bases before I could design something, adding the fact that nowadays, the museum does not hold ways to measure if people learn or not. The second was that it would have involved working with children, and in a public environment like this museum it seemed complicated to recruit children that attend this museum randomly as part of their school curriculum, and to get an REB approval I would have needed to convince their parents.

To select a specific adult population I used the visitors' journey and fields of action and contrasted different disabilities across each field to identify which disability was less included at each stage.

	PLANNING	WELCOME	START	NAVIGATION	ROOM TRAVELLING	ATTENTION TO AN OBJECT	EXIT
Deaf	80%	80%	100%	100%	100%	70%	100%
Blind	20%	0%	0%	0%	0%	0%	0%
Mobility disabilities	100%	90%	90%	70%	60%	70%	100%
Cognitive disabilities	10%	30%	0%	0%	50%	50%	10%

Figure 7. Table of disabilities attended at each field of action

The figure shows how the museum intentionally or accidentally has resolved accessibility issues for each disability group by assigning percentage figures that represent how much of that stage can be accessed by a visitor with a disability on his or her own. I only looked at the general

disabilities I knew most about because my project didn't allow enough time to dig deeply into more disabilities and research to make a sample selection decision.

The content of this model was informed by the contextual interviews, the observations and the information the stakeholders were able to give me. In the end I decided to choose the blind population, because my hypothesis was that people with a vision disability were the most forgotten group by the museum and probably couldn't have an experience of this museum at all. Everything in the museum is meant to be seen, and even the few things that can be heard, do not describe in a way they could be understood without seeing. My guess at this point was that blind visitors would be mostly bored and probably felt completely excluded.

My decision led me to search into the context of the blind, a context that was entirely new to me. I now had to find a group of people who had vision impairment that would be willing to participate in my project. It is worth mentioning that at this point in my life I had never met anyone who had a vision disability in Mexico.

By this point my research question changed to:

How can the Museum of Natural History and Environmental Culture in Mexico City become a more inclusive space for Mexican visitors, with a vision impairment, through its interactions and learning experiences?

## Research methods plan

To address this question I designed the following research plan:

**Recruitment introduction:** when I first were to contact each candidate and invite them to participate, I would introduce the project and they would introduce themselves, talk to me about their disability and their previous experience with museums.

**Shadowing Interviews:** individual interactions with each participant where I would accompany them to the museum and shadow their visit while they talked to me about their impressions and their experience.

**Co-design sessions:** after detecting all of the barriers for inclusion at the museum, we would get together to ideate solutions for the most impactful problems and prototype the ideal solutions for these.

**Prototype and User test:** based on their low fidelity prototypes I would make a higher fidelity prototype that encompassed as many of their ideas as possible and then install it on the museum. Then it would be tested by the general public and by the same participants to search for areas of improvement and refining.

Luckily enough, I didn't find any barriers along the way of implementing this plan, so it was held exactly as planned and as specified in the REB application. In the next chapter I explain the general findings and most important insights from the performance of these research methods.



## Chapter five

### Understand

#### Participants recruitment

My first recruitment attempt was looking up institutions for the blind. To do this I contacted one of my college professors who has worked with haptic design for years. She encouraged me to contact two organizations that work with blind people and warned me about the protocols I would probably have to go through. As I contacted them, they both set barriers for the recruitment because they asked me for economic compensation for the groups that I were to invite, otherwise they wouldn't allow me to contact them.

The second attempt was posting on Facebook asking for people who had a vision impairment who would be willing to work with me on a design project for the museum. Surprisingly enough, I ended up having a list of thirty candidates from varied sources and contacts in common, who lived in Mexico City, were over 18 years old and had a vision impairment. I searched to have a group that was as diverse as possible within these two requirements, but I depended on voluntary participation. At no point did I reject any candidate who was willing to participate. I called each candidate to explain the project and ended up gathering a group of twelve participants who were willing to participate on the first phase of my research: shadowing interviews.

#### Shadowing interviews

The group that participated in the shadowing interviews consisted of 12 people, 8 women and 4 men all between 25 and 65 years old. They all had different forms of vision disability.

All of the participants signed a consent form giving me permission to use their age and basic information about their disability for sample description without relating their personal information to their profile. This sample doesn't represent the overall population with a vision impairment in Mexico City, but it does give some context of Mexico's reality with regards to this topic. It is therefore worth mentioning that only half of the group have received post secondary education, and work in formal jobs. Some from the other half didn't have access to higher education and work in institutions for the blind teaching blind people how to live with their disability; others work in awareness for the public about the blind population or guide dogs inclusion, and some of them work at jobs that don't require a college degree.

Eleven participants used an iPhone as a personal device for communication and were familiar with this interface, the twelfth participant didn't use a mobile device for preference reasons. They all expressed they felt more independent ever since accessible iPhones arrived because they can call up Uber transport services, chat with their friends and family, make calls, read, search on the internet, and so forth.

Half of the participants had been to the museum before, most of them went when they were kids and what they remembered about their visit was, among other things, that they were allowed to touch certain objects, and for most of them, it was the first time they had touched certain animals and discovered their shape and size. All of them had gone to other museums before and experienced diverse forms of inclusion in these spaces such as touching replicas, specific objects, audio descriptions, special tours, and other interventions. Their previous experiences influenced their perception of the subject museum. I will only elaborate on the findings from the interviews that have to do with their experience of the museum. However, other information was collected that is not directly relevant to this project.

## Chapter six

### Sensemaking

#### Synthesis of findings and insights

Although most times the staff was available and willing to help them, it was clear there was a lack of professional training showing how to interact and help blind visitors, therefore, they tended to make mistakes. These left the participants feeling excluded: staff showed hesitation when approaching them, they didn't know how to guide them around, they made nonsensical comments such as "as we can see", "as the diagram shows", "as you can read", "whenever you see a sign like this one...", and so forth. Some of them showed a failure to guide the participants, as they realized it is difficult for them to effectively access information because it is all in written form, and based on sight.

Many visitors are unaccustomed to seeing people with a vision impairment hence they showed rejection, inappropriate reactions, and sometimes disrespect to the participants. Children as well as adults often stared at patrons with disabilities, crowds would bump into them or step in their way, not mindful of their condition, putting them in risk of tripping or getting in front of them to get to an exhibit first. One man got upset when I was guiding a participant through an exhibit because he wanted to stand in a spot to take a picture of her daughter and there wasn't enough space for the three of us; he used aggressive language towards us.

It is difficult for the participants to use their navigation techniques in this space because they encounter architectural barriers and a complex distribution of space; they explained they are accustomed to getting basic coordinates by detecting the edges and then create a mental map

of the space so they know how to move around to navigate. But the museum's building was very difficult for them to map because they couldn't find linear pathways nor edges. There isn't a basic map they can access to understand the distribution of the vaults and therefore it was impossible for them to advance without guidance from someone sighted. They had trouble familiarizing themselves with the space because there were constant shifts from outside to inside, a range of loud spaces to quiet spaces, soft floors to rocky or bumpy grounds, and all of this spread around inconsistently.

Additionally, there are some dangerous elements that could hurt blind patrons: following using tactility on the ground by themselves is challenging because there are some diagonal columns, hanging tree branches and other objects they can step into with the upper part of their bodies, which could hurt them if they walk by themselves.

It is frustrating to have spent years on special training as a blind person learning how to accept oneself as a person with a disability, learning how to use a cane, a guide dog, to read braille, to use electronic devices; and then live in a country where public spaces don't have the infrastructure which allows them to use these learned skills.

In spite of the participants' strong hearing sense that allows them to notice sounds quicker than people who are sighted, they became very confused with the diverse sounds coming from speakers because they couldn't relate them to a specific subject or exhibit: as they entered the four vaults exhibition area, they would stand still for a while concentrating on a sound they could hear, and trying hard to determine what it meant. For example, they could hear birds, wind and other sounds from far away but they couldn't tell if it was coming from an exhibit, nor

could they tell what animals were represented by the sound, and they wondered if they were just soundtracks or they were meant to help describe something.

Different from the sighted visitors who are overwhelmed by the written content overload and the saturation of attractive elements, making it difficult to learn more about a subject, these participants aren't affected by visuals. Thus, if a staff member explains a subject, they fully concentrate and end up retaining the information. When the journey was complete, they could talk about what they learned in full detail and showed clear comprehension of the messages.

With respect to their interactive experience, the same way sighted visitors enhance their understanding if they hear in addition to seeing, vision impaired visitors ground their understanding further if they are able to touch in addition to hearing. Unfortunately, the hearing and touching interactions in the museum didn't work for them because they were all based on visual cues: if they touched a button the output was visual and if they heard an audio it wasn't understandable without seeing a video or image.

A highlight they can have during their visit is when they are offered to touch something, otherwise they don't find value in coming into the museum; with a third of the participants there was the good fortune to have a staff member invite us to join the Biolaboratory area where interactive presentations are facilitated by a biologist. During these presentations, participants were given some dead insects to touch and they received orientation information about what they were touching.

One lucky participant was allowed to touch a fossil replica that a staff member was carrying, giving him a clearer idea of what the guide was talking about.

Another fortunate moment with a different participant was that a staff member in charge of explaining the Coral Reef diorama to visitors, was using stuffed animals to show some sea creatures that live in the coral reefs but weren't found in the corresponding diorama. The stuffed animals gave the participant a simple idea of the shape some of these creatures have, notwithstanding the textures and sizes represented by the stuffed animals weren't accurate.

All in all, the participants reinforced my hypothesis: their experience of the museum is minimized because there is little for them to do there and none of them showed interest in coming back. The vision impaired patrons miss out on everything sighted people experience: information, attractive objects, surprising facts, learning, understanding what nature elements are like, discovering, having a pleasant time, games, activities, tours, and so forth. It would be easier for them to search out topics on the internet to acquire some learning, but without the social engagement benefits.

The interviews helped us all understand more about inclusion problems in this museum, and helped me to understand further the participants' ways of interacting.

### **Early ideation and desktop research**

During the shadowing interviews, the participants told me about different solutions they'd discovered over the years, not only in the museums context but in many areas of their lives. I used many of these solutions as references and researched more about them. I also searched for local and international solutions that could work for the museum.

One of the ideas that kept circling in my mind was to create an inclusive interactive map of the museum so that people would know where to start and where to go. My college teacher was kind enough to show me pictures from the Museum of Tomorrow,<sup>21</sup> where they took care of accessibility since its inception. There are tactile maps at the entrance of every exhibition showing what can be found in there and how the space is distributed. I took this practice as inspiration and during the Summer Intensive Program in Toronto, 2018 I prototyped a map for out final projects exhibition. I wanted to test my own mapping skills, the implications I would have and use the opportunity of testing it with blind visitors.



Figure 8. Tactile map of exhibition and tactile video screen at Museum of Tomorrow

<https://bluetrunk.org/accessibility-at-the-museum-of-tomorrow/>

I used basic material to make a tactile model of each of my classmates exhibit in the exhibition and formed a tactile pathway people could move their fingers through. The idea was that it gave the visitor a sense of the space and where each exhibit was. Then I used a PenFriend

<sup>21</sup> "Accessibility at the Museum of Tomorrow - Blue Trunk Foundation." Accessed March 2, 2019. <https://bluetrunk.org/accessibility-at-the-museum-of-tomorrow/>.

Audio label device to experiment how these devices work. I placed a tag on each exhibit representation, plus one at the beginning for introduction and recorded the correspondent descriptions. As visitors entered the exhibition, they would hold the pen, move it close to a tag and it would call out loud the description of that exhibit and what could be found there.



Figure 9. Tactile map prototype at OCAD 2018 summer intensive exhibit

Photos: Alejandra Bortoni

During the test at the exhibition day I found a few areas of improvement for the tactile map. The representation of each exhibit was difficult to achieve because the ones I had were semantically inconsistent, some had an object representing the subject but some had physical



representations of how the exhibit was installed. Another finding was that the scale of the place, in spite of being adequately measured, gave the visitors the sense that the room was huge, but when they travelled it, they didn't feel it was that huge. The pen of course had the disadvantage that it could only be used by one person at a time, it had a chord that got in the way when moving it around, and the sound wasn't very good.

This idea of a map was my own, and having tested it I could tell it would work for one of the stages of the visitors journey. But for the purpose of this research project, the solution ideas had to be co-created with the participants to be in fact, inclusive.

At the time of the Summer Intensive I had the chance to test another student's project that later on informed part of my co-design (unfortunately I do not remember the student's name, nor the project's title). The project was an interactive translation of a Van Gogh landscape painting using a Kinect device. I wore a set of headphones and stood up facing a screen with the image of the landscape painting largely displayed. As I moved around I listened to the sounds the elements of the painting would do if I were inside the painting in the middle of the landscape touching them. So if I reached with my hands upward I would listen to the birds flying in the sky of the painting, and if I moved my hands at a knee level I would listen to the tall grass moving against my legs.

Another moment that strongly influenced my future decisions was a trip I had the chance to take to New York where I visited two extraordinary exhibitions at the Cooper Hewitt Museum *The Senses: Design Beyond Vision*<sup>22</sup> and *Access+Ability*<sup>23</sup>. I went through every element of

---

<sup>22</sup> "The Senses: Design Beyond Vision ...." Accessed September 5, 2018.  
<https://www.cooperhewitt.org/channel/senses/>.

each of the exhibitions and documented as many ideas as I could. Some of my observations and interactions with the exhibits will be referenced later in this paper.

### Definition of focus and scope

After the Shadowing interviews, the next step was to collaboratively ideate and co-design solutions for the problems we identified at the museum. When planning the codesign sessions, I realized there were too many possible ideas to implement, in the same way too many had already come out during the interviews and during my own desktop research. Using the visitors' journey I categorized all of the ideas into four fields of action, each field having one guiding question that represents the participant's problem and area of opportunity. This way we could focus on one single field and codesign to answer that question.

The categories were named: diffusion and drivers solutions, navigation solutions, interaction with the exhibition room solutions, and interaction with exhibit or object solutions.

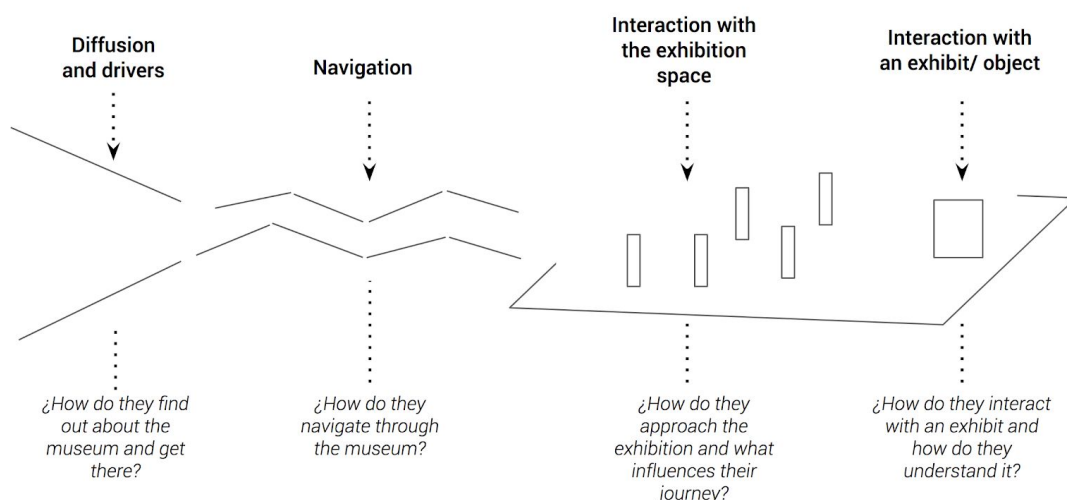


Figure 10. Fields of action

<sup>23</sup> "Access+Ability | Exhibitions | Collection of Cooper Hewitt, Smithsonian ...." Accessed September 5, 2018. <https://collection.cooperhewitt.org/exhibitions/1141959921/>.

- **Diffusion and drivers:** how do people with vision impairment find out about the museum and plan their visit?
- **Navigation:** how do people with vision impairment navigate through the museum?
- **Interaction with the exhibition room:** how do people with vision impairment approach an exhibition and what influences their journey?
- **Interaction with the exhibit:** how do people with vision impairment interact with an exhibited object and how do they comprehend it?

I classified each solution idea that had come out until this point into the correspondent category, the complete list of ideas per category can be found on page 105, under appendix E. This classification helped me choose one category to focus on. My selection was based on three influencers:

1. The interviews insights: I realized the exhibits were the core of the museum, and even if navigation and other fields were remedied, if the participants couldn't interact with the collection, they still wouldn't visit the museum.
2. The scope of the project: making changes in a larger scale such as architectural or complete exhibition area changes was difficult with the time frame I had, and the museum's willingness to make adjustments.
3. The state of the art: the participants and I talked about other solutions that had been put in action in other museums, and that we know would work for this museum solving several problems. But in the Interaction with the object area we didn't have that many references nor ideas that could solve the issues of this phase, and it presented a

challenge because it is the collection itself what we would be affecting. We thought it was an interesting field to explore with this project.

As I decided to work at an Interaction with the exhibit level, I joined the Multisensory Lab class in Fall 2018, as part of the Inclusive Design curriculum. The course helped me accelerate my process and work with this field for the co-design. The course aimed to create translations of artworks at the Art Gallery of Ontario (AGO). By translations, the course meant interpretations of an artwork, taken to a new way of interaction that would make the artwork accessible to more people by involving more senses, hence, the translations were named *multisensory*.

There is a good example of the term translation in *Taste of Music*<sup>24</sup> one of the exhibits from the *The Senses: Design Beyond Vision* exhibition. This exhibit consisted of a series of buttons named after tastes such as “bitter”, “salty”, “sweet”, and so forth. Each button played short musical composition that represented the corresponding taste.

The course faculty allowed me to work locally and create a translation of an exhibit from the MNHEC. To choose the exhibit I was to translate I made a selection of the most popular exhibits at the four vaults exhibition and thought of the benefit of translating each:

#### Diplodocus Dinosaur replica (Jurassic)

- Main attraction for visitors in the Evolution of Life area, because of its size. Visitors constantly ask for this exhibition because of the dinosaur, they all want to see it and children are always impressed by its gigantic size.
- There is a special tour around the dinosaur.
- The replica is situated on a stand in the middle of the room, and its surrounded by a 2 metre high glass. The setting allows people to go around the dino and see it from

---

<sup>24</sup> "1002, Taste of Music, 2011 | Objects | Collection of Cooper Hewitt ...." Accessed September 5, 2018. <https://collection.cooperhewitt.org/objects/1159162397/>.

different angles.

- Guides are often reminding visitors not to touch the glass, the only way to interact with the dinosaur is by looking at it.



Figure 11. Diplodocus Dinosaur at the MNHEC

Photo: Alejandra Bortoni

### Megadiverse Mexico Dioramas<sup>25</sup>

- These dioramas are the main objects that attempt to communicate to visitors how diverse Mexico is in terms of natural ecosystems.
- There are 13 dioramas in the “Megadiverse Mexico” section. Each diorama shows what an ecosystem found in Mexico looks like: desert, forest, jungle, coral reef, and so forth. They are scenes represented by real size animal replicas.
- Visitors look through the glass from different angles of the dioramas, and can observe animals and plants.

---

<sup>25</sup> "Museo de Historia Natural - Conjunto de Cuatro Bóvedas - Sedema." Accessed May 23, 2018. <http://data.sedema.cdmx.gob.mx/museodehistorianatural/index.php/exhibiciones-y-colecciones/exhibiciones-permanentes/conjunto-cuatro-bovedas>.

- On the side walls of the dioramas, visitors can read information about the ecosystem explaining where in Mexico that ecosystem can be found, and its main characteristics.



Figure 12. Dioramas at the MNHEC

L/R. Desert Scrub. Cactus Desert. Mountain Mesophyll Forest. Coral Reef. Coniferous and Oak Forest.

Photos: Alejandra Bortoni

I chose to work with the dioramas because they are diverse and that stimulated the use of different ideas. My reasoning was that by translating one of them, the process could then be repeated to translate the rest, providing greater impact. I went back to the museum to document what each diorama contained and the information on the labels.

About this section of the museum:

According to the museum, the term *megadiverse* is used to signify the countries that concentrate the largest number of endemic species (species that do not live elsewhere), vascular plants, and vertebrate animals. The megadiverse concept was created to call attention to the importance of these territories for their uniqueness in their plant and animal species' diversity, and, to search for protection protocols.<sup>26</sup> Currently only 17 out of the 190+ countries that are recognized internationally are considered megadiverse. The visitor at the museum will encounter this section: Megadiverse Mexico, which aims to communicate the country's richness and explain what some of its protected natural areas are like. A list with the thirteen dioramas found in the museum can be found in page 115, *appendix I*.

I had an interesting observation upon returning to the museum to document each diorama: some of the dioramas contained plants and animals with either no labels or other information about them. I asked different members of the staff about them and they confirmed they weren't sure about some of the elements in the dioramas as well as other animals exhibited around the museum. They confessed they weren't informed during the training about some elements and they frequently have trouble when people ask them about certain animals because they don't know what they are. I had to do some desktop research about each ecosystem and tried to associate each diorama representation to the information I found about flora and fauna of each, but don't have full information of the elements inside the dioramas even now.

With enough information about the dioramas and the decision to work with these exhibits, I began the design of the co-design sessions with the participants.

---

<sup>26</sup> "Museo de Historia Natural - Conjunto de Cuatro Bóvedas - Sedema." Accessed May 23, 2018. <http://data.sedema.cdmx.gob.mx/museodehistorianatural/index.php/exhibiciones-y-colecciones/exhibiciones-permanentes/conjunto-cuatro-bovedas>.

## Chapter seven

### Co-design

#### Plan and logistics

All the people from the first list of candidates were invited to the co-design, so even if they didn't participate in the shadowing interviews they could come and bring any other people they knew. I had never facilitated a workshop where participants were vision impaired, and I tried to remedy the challenge by dividing the participants in small groups so that everyone's ideas were heard and shared. There were four dates available for the sessions and the participants could choose when to attend. I asked some of my designer friends to help me facilitate these sessions because there were too many activities to organize on my own. I had three assistants for each session. There were 10 participants for the co-design sessions in total, 7 female and 3 male. Eight of the participants had participated in the previous shadowing interviews and two of them were new to the project.

I structured the co-design sessions in a way I could push the participants to think beyond the obvious ideas. In order to accomplish this I needed to show them what *multisensory* meant in terms of interaction, and move from there towards new ideas. The introduction section helped revive their experience at the museum to share their perceptions, remembering the problems we faced during the shadowing interviews. Then I explained we would be working with the Megadiverse Mexico section of the exhibition and thinking of ways in which the exhibits could be more inclusive using multisensorial interactions. I developed a station system where each participant would experience a different sensorial interaction at each station and use these experiences as inspiration for their solution idea.



This method was inspired by the *sacrificial concepts* method I had used in previous projects. Christina M. Chung explains what sacrificial concepts are in an article she wrote for Medium (2016),<sup>27</sup> she states:

*“Sacrificial concepts are early, raw, potentially flawed concepts made visual/physical and used as a medium for creating reaction, response, and discussion among users and design teams. We don’t spend a lot of time on the concept itself, so that’s how it’s being sacrificed. The concept is available just to understand user’s thoughts and behaviour (their world) and is not to be taken literally or for the user to be consumed by it. It’s important that the sacrificial concepts are not taken literally by users, because these concepts are usually fictitious and do not exist in real life.”*

I altered this method in a way the concepts were simple enough for participants to create a whole new developed concept idea. Each participant began at a different station, so they didn’t all go through the stations in the same order. The stations/ sacrificial concepts were the following:

1. **Smell:** participant could smell a series of jars and think of the place the smells belonged to. The jars were filled with pine leaves, mud, fresh moss, fern leaves and caudillo leaves.

---

<sup>27</sup> "Sacrificial Concepts – Christina M. Chung – Medium." Accessed October 27, 2018. <https://medium.com/@christinamchung/sacrificial-concepts-200993246364>.



Figure 13. Smell jars with forest elements, sacrificial concept

Photos: Alejandra Bortoni

2. **Touch:** participants could touch a 3D representation of the desert diorama. It was a spherical container assimilating the real spherical diorama, filled with sand, rocks, cactuses, desert plants, a serpent and a butterfly.



Figure 14. Touch diorama in scale, sacrificial concept

Photos: Alejandra Bortoni

3. **Step and hear information:** using headphones participants stepped onto a mat with four different sections differentiated by texture. On each texture they could hear a different audio explaining different characteristics of a coral reef. They were able to control what they heard by moving freely onto a different texture with their feet.



Figure 15. Step on and hear data about coral reef, sacrificial concept

Photos: Alejandra Bortoni

4. **Move and hear sounds:** using headphones participants stood up, and as they moved their legs or arms around they could hear the sounds of the elements they would be touching if they were standing in the middle of the jungle diorama. So if they moved around, they could explore and recognize what plants and animals were there by hearing the sounds they make.



Figure 16. Move and hear jungle elements, sacrificial concept

Photos: Alejandra Bortoni

5. **Hear and feel (4D concept):** using headphones participants would be sitting down on a chair and listened to ambient sounds from a coniferous forest. As they listened they would start feeling things on their skin imitating the sensations they would have if they were in fact in the middle of a coniferous forest. They would feel a mist, plants around their feet and arms and a sudden sparkling rain falling onto them.



Figure 17. 4D experience of coniferous forest, sacrificial concept

Photos: Alejandra Bortoni

After each station the participants would share their impressions, likes and dislikes. Once they went through all the stations they got together in pairs with an assistant for each pair, they discussed and started prototyping their solution idea of a translation of one of the dioramas at the museum. In the end each pair presented their idea to the group and explained why they chose a particular diorama, to be solved in that way. They invited the other teams to test their prototypes too and receive feedback.

This activity was the most insightful. Each team thought of new ways they could interact with an exhibit so that they could understand it fully. By listening to each participant express what each sense afforded them to capture, I realized what they learned from an exhibit is far more valuable than the exhibit itself.

To wrap-up the co-design sessions, we discussed other problems we had faced when we visited the museum. The participants talked about ideas for the other fields of action that were necessary if the museum wanted to offer an holistic inclusive experience for them. These discussions helped to complete the Fields of Action diagram (Figure 11) with more ideas for each category and were to become part of the broader strategy deliverable, the ideas can be found on page 106, *appendix F*.

At the end of the sessions there were five documented translation prototypes as solutions for the dioramas exhibited. The next steps were to understand the background of these ideas, and use a pattern to create one high fidelity prototype for user testing that encompassed the essence of all the prototypes generated by the participants.

### **Co-design outputs**

Firstly I collected all of the participants' impressions when interacting with each sacrificial concept to understand the decisions they made when they created their prototypes:

#### **Station 1. Smelling jars:**

- Smelling is the most successful sense to remember past experiences and immediately bring back memories, in this case, of the times where they have been to a humid forest.

- Smell is the sense that transports them more closely to the interpreted 'reality'.
- The participants don't like having to guess what they are smelling, they enjoy the sensation but would like to know what it is they are smelling, it wouldn't affect their experience because they are being informed.
- The sum of all the elements is what makes it a good experience. In this case they had to go through each jar, but they wished they could smell the forest with all the elements combined.
- They would like information along with the smell, for example, each type of vegetation in an ecosystem per jar.
- This station provoked more smiles. Their facial expressions changed the most, in a positive way, during this interaction.

## **Station 2. Tactile representation:**

- The same way they do with a room, first they touch the borders to understand the overall shape of the object they are about to interact with and secondly they start exploring each element in the container.
- There is hesitation and fear when having to introduce their hands into a container from up to bottom.
- They touch each element individually for a few seconds and afterwards they move their hands around to understand the relation between each element.
- With touch, the most important characteristic they perceive is shape. When there are several elements the location of each element is the second most important characteristic because they are able to encompass the whole composition of the representation.

- It is important for them to use coherent sizes with representations, so to have an element larger than another doesn't make sense unless it is that way in real life.
- They don't mind if the size of the complete representation needs to be smaller in terms of scale, because they know it's meant to represent a larger object, and there are size restrictions. But this scale difference should be communicated. The size of the real diorama doesn't matter to them because they cannot see it or touch it anyway, what matters is the content and the main message.
- Texture doesn't inform if it is fake or artificial, so for example, a plastic snake doesn't transmit the scaly skin of a real snake.
- To touch something with their hand keeps them engaged, the vision impaired participants like to explore and touch for long periods of time. They often touch and play with objects in their hands for general stimulus, for example, one participant loves to wear many textured bracelets because she can play with them with their hands all the time and keeps her entertained.
- Touch is the sense they prefer to interact with.

### **Station 3. Stepping and hearing mat:**

- The participants liked descriptive language more than technical, they find it more accessible.
- They wished the mat's texture was related to the information they were listening because it told them something, but when the audio didn't relate they got confused.
- The mat gives them control over what they want to hear when they want to hear it.
- Instructions on how to interact with this concept were needed.
- They thought this was the most informative station and they liked being in control.

- Touching with their feet is a very natural movement for them so that they felt comfortable.

#### **Station 4. Move and hear sounds:**

- The participants need to feel the space coordinates and limits before they start interacting so they know where they can go.
- They like to explore but don't enjoy uncertainty.
- If they are not informed of where they can move towards, they are hesitant to venture on their own.

#### **Station 5. Hear and feel (4D concept):**

- To feel like they are in the middle of somewhere is valuable to the vision impaired participants.
- They don't like surprises. Because they have a vision disability, they have enhanced awareness of their other senses, and they don't feel secure with suddenly feeling things on their skin without previous notice.
- The fact that they listen to sounds at the same level in the soundtrack makes it feel artificial, they would like to hear each sound at the proper distance to give it more context and make it more realistic.
- Hearing an audio or description is something they can access through the internet at home, this station was engaging because the opportunity to interact with the exhibits using their other senses represents the true value of going to a museum.



### Overall findings:

- Vision impaired patrons' first interaction influences them to be ready for the next one.
- They would like the exhibit to tell a story.
- They search to have control over the interactions.
- Audios are best if acoustics are treated to create good sound.
- They don't like to guess, but to be informed.
- Low or no vision increases their ability to concentrate and isolate the sense they want to use in order to increase its benefit.

By dissecting each prototype and trying to understand what was behind their ideas, I realized each way of interaction and each sense is more or less functional for a different piece of information. In the context of ecosystems, some ecosystems are better understood by touching than others, and the same logic applies to smelling or hearing. For example, a desert is better represented by textures than by smells, people can touch sand, cacti rocks, more than they can smell these elements. On the contrary, a forest is transmitted more effectively by smell because there are more diverse olfactory elements in it, and it's easier to bring back related memories. Ideally, each element of the content should have an appropriate interaction to be communicated and understood.

I made an exercise of matching what one diorama originally communicates in its label, with what the participants' prototyped as their ideal solution to work with a specific example.

The exercise lists the pieces of information from the Mesophilic Mountain Forest and matches them with an ideal way of translating it according to the participants' ideas:

Bosque Mesófilo de Montaña (name of ecosystem) - *hear*

El Triunfo, Chiapas - *tactile map*

Less than 1% of Mexico's surface - *tactile map*

High diversity of vegetation - *smell or touch*

More than 500 species of plants - *hear*

Vegetation: Epiphytes, orchids, bromeliads, arborescent ferns and mosses - *smell or touch*

Trees: liquidámbar, oaks, pines - *smell or touch*

Gathers a large number of endemic species - *hear*

Wildlife: quetzal, peacock, dragon lizard, salamander - *touch*

Mountain regions with humid weather - *touch*

Pronounced slopes and ravines - *touch*

Frequent rain, cloudiness, elevated humidity - *feel and breathe*

Máximo 31° C, minimum 13° C - *feel or hear*

Precipitation from 1000 to 4,400 milliliters per year - *feel or hear*

Altitud: 450 to 2450 meters above sea level - *touch*

Doing this exercise and revising the participants' prototypes over and over again, helped me sketch an initial idea of a translation of the Mesophilic Mountain Forest diorama.

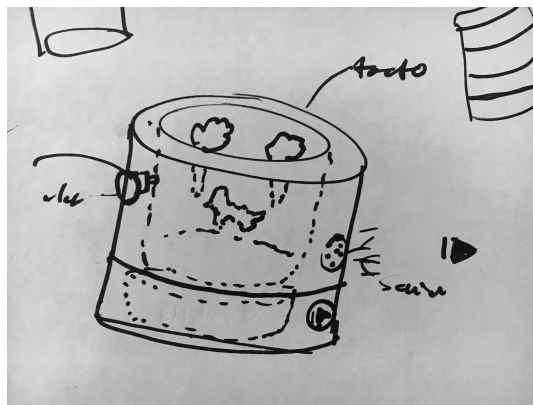


Figure 18. First sketch for diorama translation

At this point I reflected upon a discussion we had in class regarding the statements made on the following readings: *Redefining Access: Embracing multimodality, memorability, and shared experience in Museums*, by Alison F. Eardley, Clara Mineiro, Joselia Neves, and Peter Ride<sup>28</sup>; *In the Multisensory Museum: Cross-Disciplinary Perspectives on Touch, Sound, Smell, Memory, and Space*, by Nina Levent, and Alvaro Pascual – Leone<sup>29</sup>; and *A New Model for Access in the Museum*, by Carmen Papalia<sup>30</sup>.

The three readings offer great references and sources of theory, in-detail research about the museum's experience, discoveries and statements regarding disabilities, trends and contemporary practices, multisensory fundamentals, and much more. Great examples of contemporary museums that have implemented multisensory practices. New regulations, recommendations, rules, arguments that convince readers and practitioners that museums should think about multisensory experiences and why. My own reasons and ideas were nourished and I learned a lot about the connection between senses, the impact that multisensory experiences have on our engagement, our memorability, and our understanding. I also learned about each sense, and what each sense can tell our body.

As I read, I kept reflecting on a conflict between trying to make an existing exhibit accessible vs. creating an inclusive exhibit from scratch. In relation to our translations project, there is a subject worth debating: when translating an object (presenting it in a different form that allows it to be accessed by other senses), will we be making the object accessible maintaining its original essence? or will we create a whole new experience for that object that ends up transforming its original essence?

---

<sup>28</sup> Alison F. Eardley, Clara Mineiro, Joselia Neves, and Peter Ride, "Redefining Access: Embracing multimodality, memorability, and shared experience in Museums." In the Museum Journal, 2016.

<sup>29</sup> Nina Levent, and Alvaro Pascual – Leone. "Introduction. In the Multisensory Museum: Cross-Disciplinary Perspectives on Touch, Sound, Smell, Memory, and Space." (Ed. Nina Levent and Alvaro Pascual-Leone), 2014.

<sup>30</sup> Carmen Papalia. "A New Model for Access in the Museum." In Disability Studies Quarterly, 2013.

I realized that when translating an object to other mediums, for more senses to access it, a lot comes into play:

- our own interpretations of the object?
- specific users ideas on how the object should be experienced?
- new affordances?
- new information that wasn't told before by the object's original form?
- new ways of understanding the object?

I kept thinking about the inclusivity cart at the AGO and the translations projects developed for it by groups of students in the past and by my own classmates. A translation of an artwork, for example, of a painting, could be a musical composition that represents the painting, or a tactile element with different textures that represents the colors of the painting. If this is how we understand translations, I wondered if it isn't unfair to have only certain people experience the artwork in a different way, and are the translations direct conversions of the same experience into another sense, or are they expansions of the object that would completely change the experience and interpretation of anyone who would access the artwork? Are the translations, in fact, new artworks themselves?

By asking myself these questions I thought of the examples and arguments explained in the readings. When we talk about artists creating something, or designers designing something, which is later shown to the public in a museum, the ideal process would be for the creators (artists and designers), to be aware of the interactive affordances of their work and how the public will engage with it.

Following this line, the challenge for museums that are searching to change the way the public interacts with existing exhibits that are not multi-sensory nor inclusive, is to analyze these exhibits affordances and signifiers, and include end users in the process of deciding how to make translations of these subjects. But ideally, museums should search to curate selecting artworks or objects that are accessible from their essence, or, like Paloma Oliveira practices, encourage artists and designers to think of multisensorial interactions for their creations from the start. Thus, I believe it is inevitable to influence the public's perceptions of the exhibited artwork or object when its translators are not the original authors or designers of those objects.

Wouldn't we be deciding for the public what they should perceive or understand? How can we avoid influencing the public's experience in a certain way, respecting the creator's intent, but making the exhibits inclusive?

As one of the readings explained: for certain visitors, the difference lies between accessing the translation and not at all, so in these cases -yes- it is great for the people who didn't have access at all to now be able to experience an object with other senses.

If we are using the term *multisensory* and we want all people to be able to engage with objects, how much of the understanding of an object will we manipulate when we translate elements that were originally, only visual or only auditory? What should we take into consideration in order to make objects as closest to the original as they can be?

Regarding the conflict between trying to make an existing exhibit accessible vs. creating an inclusive exhibit from scratch, there is a subject worth debating: when translating an exhibit,

will we be making the exhibit accessible if we translate it as it is? or will we be creating a whole new experience for that exhibit?

This questioning made me realized that the participants in this project don't want to know what is in the museum or how it is exhibited today, they want to access the content for their own learning, comprehension and reflection the same way other visitors do. In other words, it is the **forest** itself that should be translated, not the **diorama of the forest**.

Under this reasoning I discarded the initial sketches and set to focus on what the content of a diorama wants to communicate beyond its current form. I used the affordances, signifiers and conceptual models theory from *The Design of Everyday Things* by Don Norman.<sup>31</sup> The variation with Don Norman's book is that it talks about *using* designed objects, and how an object's interactions are designed for its proposed use. If the museum was in fact, interactive, people would interact with the exhibits, but the verb shouldn't necessarily be use for the use the exhibits, it could be use to *understand* the exhibits. So visitors would interact with the exhibits to *understand* what they are trying to communicate. But like I stated before, in designing inclusive exhibits, it wouldn't be the current exhibit we were communicating, but the subject of the exhibit.

Following this line of thought I made the relation to the forest diorama. So if the forest is the object, not the diorama of the forest, I had to think of the forest's affordances and signifiers. If an affordance is *humidity*, what signifiers will make a user understand humidity? what signifiers did users prototyped during the co-design as the most functional and why?.

---

<sup>31</sup> "Definition: Affordance - Intro to the Design of Everyday Things - YouTube." Accessed October 27, 2018. <https://www.youtube.com/watch?v=a6F0EYCUjcE>.

As I made all the connections, I kept clear that no signifier exists without an affordance, so on the first level there are always affordances.

As I dug deep into Don Norman's theory, I realized it is worth questioning it. Most of his definitions give for granted that a person can see. He states that the design of everyday things is about how things look, how they work and how they feel. But for users that cannot see, there should be other signifiers that allow them to use, or understand an object.

The following table explains my idea further using as an example a real forest:

REAL FOREST: Subject			DIORAMA: Translation of subject		PROPOSAL: Translation of subject	
AFFORDANCES	SIGNIFIERS	ACCESS	SIGNIFIERS	ACCESS	SIGNIFIERS	ACCESS
-Humidity	-Water/wet environment -Ground texture	Touch Smell	-Water effect in diorama with light reflection	See	-Soft humid ground of the model -Audio about the humidity levels and the additional name "Cloudy Forest"	Touch Hear See
-Temperature	-Wind -Cloudy sky	Touch See	-Additional title of diorama "Cloudy Forest" on lable -Temperature range written on label	See	-Audio about the temperature range written on label	Hear
-Freshness	-Air -Plants odor	Smell See	-Light reflecting on plants and scenery setting	See	-Smell of fresh plants through hole -Audio with sounds of wind and water	Smell Hear
-Color	-Light showing colors	See	-Colored elements in diorama	See	-Color of plants on the model	See
-Plants	-Texture of plants -Sound of plants with wind -Smell of plants	See Touch Hear Smell	-Plants replicas in the diorama -Text about some plants written on label	See	-Plants replicas on the model -Audio about the vegetation and plants found -Smell of the plants through hole	Touch Hear Smell See
-Animals	-Sound of animals -Shapes of animals	Hear See	-Animals replicas in the diorama -Sounds through speakers -Text about some animals written on label	See Hear	-Animals replicas on the model -Audio with sounds of animals -Audio about the animals	Touch Hear See

Figure 19. Translation of affordances and signifiers

The table shows on the first column each affordance a real forest has and what signifiers in it tell us that in fact, an affordance is there; on a different column the senses through which we access the signifiers and hence, understand the affordance are listed. On the second column it

shows how the diorama of the forest works: what signifiers on the diorama transmit us the affordances of the forest and through which senses we access these signifiers. On the third and last column it details the proposed translation, evidencing how new designed signifiers allow more senses to access these and therefore, understand the affordances of the forest through more possible ways. The translation would effectively have new multisensory signifiers that broaden the possibilities of how to interact with the forest by accessibility and understanding of its affordances. These insights helped inform the replicative model and the strategy I developed by the end of my research project.



## Chapter eight

### Prototype

I then used the table to create a high fidelity prototype. Its purpose was to combine all the participants proposed ideas into one that could be user tested.

I continued using the Mesophilic Mountain Forest diorama for practical reasons. I used the content of the current diorama as the elements/ affordances to be translated in the prototype.

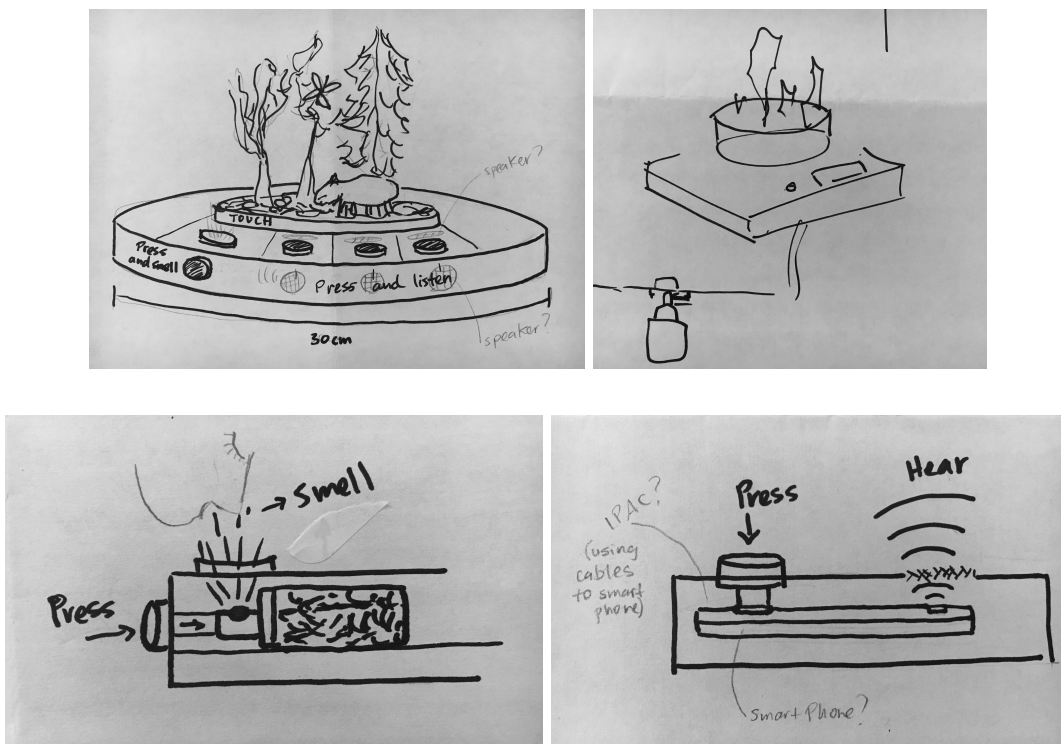


Figure 20. Second sketches of prototype

I chose the different interactions the prototype would have, based on the co-design conclusions, and I thought of viable ways of prototyping on the short-term.

As I put the different interactions together, I thought of an horizontal surface that allowed visitors to move their hands around and explore the interactions.

The prototype took its form based on each interaction's limitations such as the tactile representations' size, the button's size and form, the smell output size and form, the space for testing it at the museum and also, the need of carrying it to transport it to the museum.

By taking into account all of these implications I sketched a final prototype, Figure 12. It is a 50 x 40 x 6 centimeters surface with a row of four buttons on the front, the third button located on the perpendicular side of the surface because its place in the row is occupied by a lid that opens a round smell output. Behind the row of buttons there is a tactile model of the forest with the same elements the diorama contains: the same plants and animals in the same position. On the left side of the tactile model there is a label that informs what this translation is and what it attempts to do. On the left top corner of the surface there is a sound output, little holes forming a circle, imitating a speaker surface. Each button plays a different audio and the audios go in chronological order from left to right but are independent from each other. Figure 21 shows what each interaction contains.

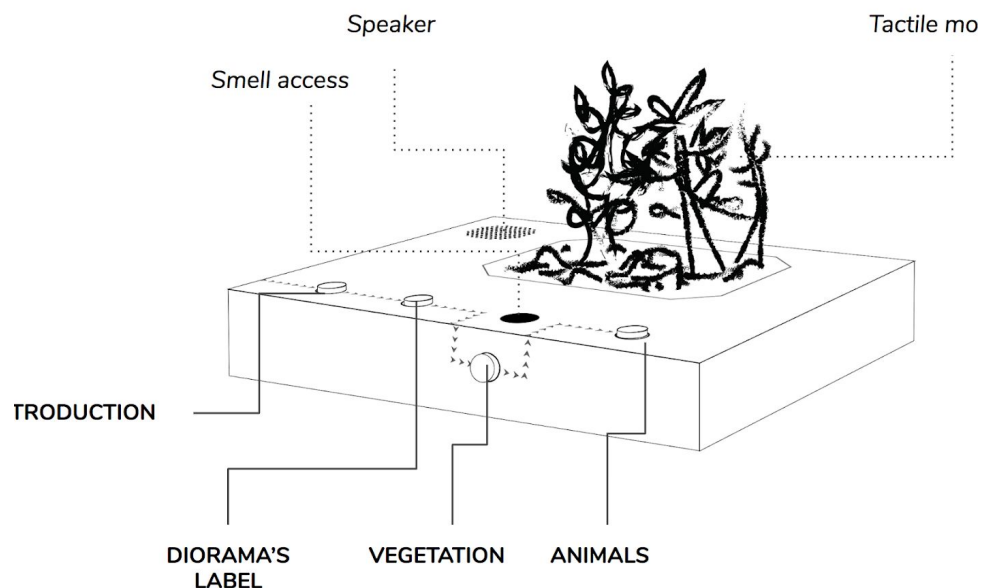


Figure 21. Prototype Sketch

I built the surface using laser-cut shapes and put it together with glue.

To make the sound work I used an IPAC, arcade buttons and a computer. The buttons were cabled to the IPAC and the IPAC to the computer. The computer then was connected via bluetooth to the speaker.

I programmed it using Processing and recorded audios with my own voice and with extracts of original audios from the National Commission for the Knowledge and Use of Biodiversity for Mexican Biodiversity, *Cloudy Forests*.<sup>32</sup> The code specifications can be found in the appendix D, page 104. I constructed the tactile model using ceramic clay, paint and other crafting materials. The label was simply printed out.



Figure 22. Prototype of translation of Mountain Mesophyll Forest

---

<sup>32</sup> "Ecosistemas de México - Bosque nublado - Conabio." Accessed September 19, 2018. <https://www.biodiversidad.gob.mx/ecosistemas/bosqueNublado.html>.

## User test

To test the prototype I first presented it to the museum's Director and the Education department Director. They approved the prototype but asked me to add a disclaimer explaining the prototype was part of a research project and not created by the museum.

As soon as I added the disclaimer I scheduled the first test on a Saturday from 10:00 a.m. to 1:00 p.m to make sure as many visitors could test it as possible. I invited all of the participants from the project to attend the public test. The results in detail can be read in the complete report on page 108, appendix G.

The main findings for the user test were the following:

- Most visitors started pressing the buttons as soon as they got closer.
- Some visitors asked if they could touch the tactile representation because they came from touching-restricted areas of the museum so it was apparent that they felt uncertain if they were allowed to touch the prototype.
- Most visitors read the description and disclaimer; only two women asked about the concept's reasoning and background of the prototype.
- Very few asked how to open the smell output.
- The best engagement happened when I stepped away from the prototype stand and people would come on their own and start exploring, they would start touching the buttons immediately.
- Most visitors understood the prototype as an extension of the diorama and assumed it was a temporary activity offered by the museum until they read the disclaimer.

- Many visitors asked for the name of the grey bear-shaped animal (Tapyr); a few asked about the region, if it was endangered and where in Mexico it was found; five visitors asked if the region still existed or had been destroyed.
- Two people asked for the names of the plants represented.
- Some children would touch the jaguar and then run towards the diorama searching for the jaguar behind the glass.
- Three teenagers asked about other subjects they couldn't find information about that they needed to complete for their homework.
- The sensation of touching the ground, the rocks, the trees and the shape of the animals was what visitors grasped more effectively. The same effect had the fresh smell of the pines inside the glass container.
- Eight adults left the audio running, as they touched and smelled, they listened to the information about what animals and plants are found there, what is produced in this region and what the weather is like. They all looked surprised and repeated this information to their children.
- In relation to scale and size: most visitors thought it was fun to have the diorama represented smaller but each element in correct scale. They mentioned size could be bigger because they weren't able to move their hands in between objects with much freedom and I was able to observe that when reaching out for the tactile representation, a few bumped on the buttons accidentally and changed the audios because they were in the way.
- Height: the person in a wheelchair had trouble reaching the smell output, and also had to reach too far to touch the tactile representation.

- In terms of perception of abstract conceptual aspects: they put their attention to the beginning of the audios, but wished they were shorter and clearer with only interesting facts. Audios helped them learn new facts, but they concentrated more on the prototype because they were touching and exploring while listening to them. The smell interaction was a great hit, it awakened curiosity, and they all felt like it gave them a better idea of what that forest is like; some started talking about their own trips to forest areas and what they like the most about them by memory. As they smelled many would answer the question from the audio “what smell do you recognize?” with “it smells like that!” signaling the tactile forest representation.

#### Buttons and audio content findings:

- Most started with the first button to the left, only four children started with random buttons in the middle.
- **First button:** because it was the first and has the introduction and instructions, it generated high expectations, the emotional and acceptance levels were high during this button, the audio was short and clear and it was evident they had all their attention on the prototype thanks to it so all of them decided to continue using it, pressing the next button on the right.
- **Second button:** they started listening with high expectations, however, as they listened, the content got so long users lost focus, possibly because of their perception of how much longer it would continue and they seemed to lose interest. The tone was also monotonous and the language less friendly or engaging. When they lost interest and no longer paid attention, they would lose certainty as to what to do next- Wait for it to finish? Press the next button? Explore the tactile representation? This was also confounded as to whether they felt they could touch it. What is that jar for? So if I was

present, they would look back to me with expressions of doubt as to what to do next.

When I wasn't nearby, they would reach out and start touching and tried to open the lid, but wouldn't continue touching the buttons.

- **Third and fourth buttons:** some could hear from the previous groups that had interacted with it, there were other audios, so they would try to touch further buttons but none of the visitors listened to the complete long winded audios. A few experienced them as soundtracks, and started touching, smelling, or inviting others to interact with the prototype, others started asking me questions.
- **Order of buttons and elements:** the distribution of the platform lead people to interact with the elements in different sequences, so the goal of the interface wasn't linear: they were not sure if they should start pressing a button, or touching the tactile representation or open the lid. As for the buttons, not all of them started with the one on the left, and only the ones that did, continued along the line.
- **Blind visitors:** the blind visitors did touch in the intended order, left to right and were more patient to listen the all the audios through as they touched other elements. I interpret this because it was the only source they are getting information from, and they haven't interacted with other areas of the museum nor have they seen the real diorama. But for these visitors there was also the problem of no connection between what they are listening to and what they are touching.

Based on my observations I identified some **areas of improvement:**

- Blind visitors could benefit from touching more realistic animals' skin or fur.
- All visitors could benefit from having more plants or other things to smell, they all loved this part.

- All visitors could benefit from touching each element with more space in between to concentrate on each and have an audio connection to each: as they touch the jaguar, they should listen to its description and hear its real sound.



Figure 23. User testing prototype at MNHEC

#### Another general finding:

This prototype's form and distribution worked best for blind visitors. I interpreted this because I observed that the way they explored and interacted with each element felt more natural, and they did it with more autonomy, whereas the sighted users asked questions and felt unsure of what to do. The user test helped me realize how some interactions for the blind don't work as well for the non-blind. But I discovered new value in this for the non-blind: it served as a guide that explained the diorama further and invited them to look more closely at the diorama to find what they've touched in the tactile representation.



Based on my findings, the prototype should be iterated and improved with more user profiles in mind: blind visitors, non-blind visitors, people in wheelchairs, children and adults. By iterating I mean repeating not only the prototype, but the whole prototyping process to create a new version and obtain better and more effective results.

After the first test, I decided to go back and run a second one to have more feedback and give a chance to vision impaired participants that hadn't been able to make it on the first round. For the second test I fixed the technical problems, I stayed away from the prototype most of the time, and I focused on the visitors with vision disabilities' interactions. This time three participants from the project tested it and it allowed for the findings to be richer because there were more consistent patterns.

The most relevant findings that informed the required adjustments for the iteration were:

- There isn't a hint that tells people how to start interacting, buttons are appealing, but it's not clear which one to press first. Vision impaired visitors don't know they can find this, nor do they know there are buttons to press. A compelling reason to interact is needed, so that it is able to be used without a facilitator.
- Visitors would only read the posted information if I wasn't present, but they still doubted if they could touch, press and smell, despite the signs.
- The first introductory audio worked perfectly, it automatically helped visitors engage with the translation and invited them to start exploring.
- Vision impaired visitors didn't detect the tactile linear guide, so many of them didn't find the button on the front side, neither did they understand the sequence.

- They didn't find the jar lid to open the olfactory access, they skipped it thinking it was part of the surface, and felt unsure if they could open it presumably because they thought they might break something.
- The audios were too long for visitors that could see but long enough for blind visitors. Even though they contained interesting facts for all, they weren't directly related to the tactile representations, so visitors kept asking what animals or plants were they touching. Visitors wished the interesting facts were translated too, because it's what they wished they learned better through other mediums. E.g. smelling coffee or touching coffee grains in response to the audio explaining the coffee production in that area.
- When visitors started touching the tactile representation, most of them pressed the sequence of the buttons accidentally. This was the same situation with the button on the front side.
- When visitors bent to smell, their head would hit the tactile representation accidentally, so it wasn't very comfortable to explore.
- Height: tall participants had to bend too hard to reach the smell dispenser. Visitors in a wheelchair had a hard time reaching out for the tactile representation and their chair wouldn't let them interact comfortably. Most children were able to touch comfortably, but some shorter children had to be carried by their parents to reach.

## Refinement

I worked on a proposed iteration of the prototype that attempted to fix most of the problems detected during the user test. However, this iteration only reached sketches since it was impossible to build another prototype given the time frame of the project. The iteration proposal had the following adjustments:

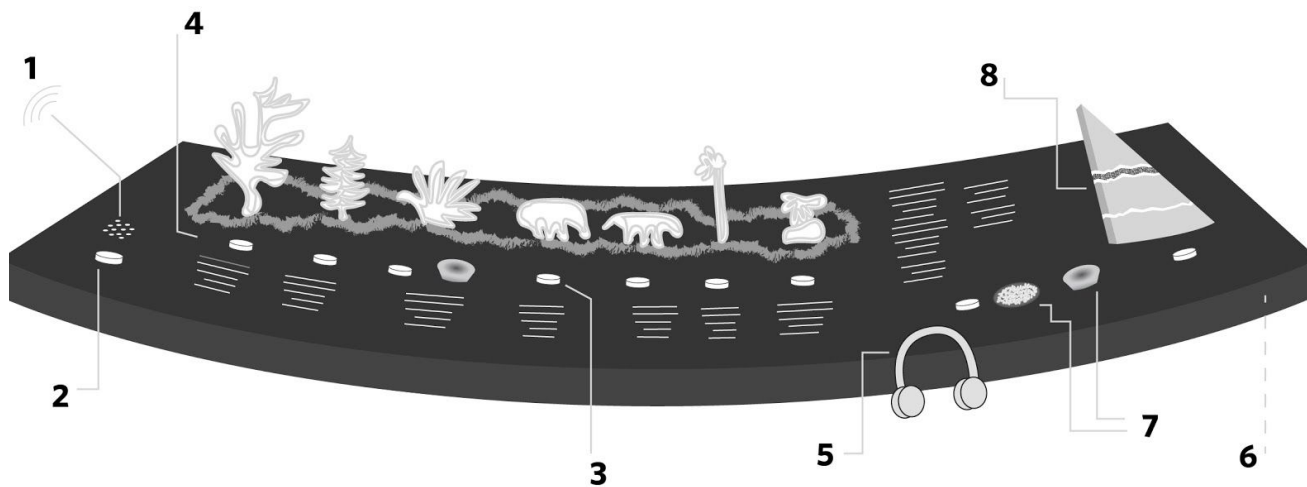


Figure 24. Sketch of refined iterated translation

1. To be installed permanently next to the diorama, it would need to have an audio, through a speaker, inviting people to get closer and start interacting with it, the same audio instructing how to start: “touch the button”.
2. There should be one button only closer to the edge of the platform that introduces the translation, like the audio from the first button that worked so well: “This is a representation of the first diorama...”.

3. The speaker should work for smaller buttons that have very short audios, ideally they should be next to the element (animal or plant) they are touching or smelling to learn about it. The audio then could combine information about that element with the sound that element naturally emits. E.g. "Rooaar! the Jaguar in the humid forest is very hard to find and is the only carnivore."
4. There should be enough space between buttons, smell dispensers and the tactile representation. There shouldn't be more than one row of elements so that people don't have to reach further and accidentally press buttons on the way.
5. To listen to longer audios (1 min maximum) with more explanation, it is best to provide headphones. This information should contain only interesting facts with friendly language. E.g.: "did you know this forests are the principal generators of the famous south coffee? Next time you enjoy a cup of coffee remember it comes from the Humid Forest from Chiapas..."
6. Height: this is challenging-, it should be short enough for children to reach and people on a wheelchair to enjoy, but tall enough so that tall people don't have to bend too hard to smell or touch. Ideally height should be easy to be customized for each visitor.
7. Smelling and touching coffee is one of the olfactory options that could be used to support the interesting facts about the forest.

8. Touching a model that represents the change in altitude of this region, perhaps showing the forest in contrast with the sea level and textured to represent the cliffs.

Other considerations:

I realized hygiene should be taken care of when having tactile interactions.

At the sensory exhibition in the Cooper Hewitt Museum I observed they installed a hand sanitizer at the beginning of the exhibition. This is important for the museum to consider if they will have many people touching the exhibits around.

The same for the smell dispensers, they should be designed so that people's noses don't have direct contact with the glass.

The refined translation proposal is one of the results of this project's complete research process and serves as an example of the use of the model developed during the post-co-design sensemaking work. But all of my findings and insights from all the research methods performed are encompassed in the final deliverables described on the following chapter.

## Chapter nine

### Deliverable

#### Model

As I got closer to the end of the process I felt confident that the reasoning that I used to make the translation of one of the dioramas can be used to translate, not only the rest of the dioramas, but other exhibits in the museum as well. This reasoning was only tested with one prototype and would have to be tested on new translations to become a proven model. In any case, it is a helpful tool that I feel obligated to share with the museum encouraging it to have a more inclusive approach in its future exhibit design.

To apply this early staged model it is only needed to fill in the cells for the table in Figure 12. The first step would be to identify the affordances the subject to be exhibited has and list them. For each affordance inclusive signifiers should be designed that allow visitors to understand that affordance. These signifiers should become multisensory ways of interacting with the exhibit that solve for diverse abilities to understand the subject of matter. By exploring multisensory interactions, more visitors will be able to access the exhibits and enrich the experience for all.

Subsequently all the interactions need to come together in an holistic composition that takes into account the learnings from the user test I performed. The easiest way to accomplish an inclusive exhibit is to think of diverse types of visitors that could come into the museum to

interact with the exhibit, and test the solutions with a diverse group of potential visitors before creating and installing the real exhibit. We can guess and assume, but without trying new interventions, we do not know what will work and what won't. The most important consideration that needs to be taken into account is that involving a diverse group of people, including people with disabilities, in the process is what makes inclusive design **inclusive**, and avoids a top down hierarchy that gives some people having the power over everyone's experiences. I will expand on this statement in the conclusions of this document.

### Strategic roadmap

This project finished with the design of an inclusive translation of an exhibit at the new exhibition of the museum. The proposed solution solves for only one field of action: interaction with an exhibit. But throughout the whole process there were many learnings and ideas that could be explored further to help the museum offer holistic inclusive experiences.

All of the ideas gathered along the project that solve for other fields of action were mapped in a roadmap that looks at actionable solutions for the short term and the long term. The museum's willingness to become a more inclusive space can be reflected in the future as it decides to take these ideas into account. The roadmap doesn't take into account budget or resources implications because it needs the museum's stakeholders' input to define these, and that encounter hasn't happened yet.

Roadmap of Interventions for Inclusion at the MNHEC				
	Less effort		More effort	
FIELD OF ACTION	SHORT TERM	MEDIUM TERM	LONG TERM	
DIFFUSION AND DRIVERS	Information about accessibility in the museum on the internet	Audio on website introducing the museum	An accessible website for the museum	Higher impact
	Broadcasting of inclusive practices in the museum	Advertising and awareness creation through inclusion organizations	Accessible coordinates and instructions to get to the museum  Audio signage at the Chapultepec Forest that helps get to the museum	Lower impact
NAVIGATION	Indicators where the restrooms are	Interactive tactile map at the entrance	Tactile floors at key junctions	Higher impact
	An inclusive feedback section for visitor comments  At the entrance, a welcoming audio to confirm we arrived at the right place, like the Torre Mayor building that has an audio reproduced every time it senses people approaching saying "Welcome to the Torre Mayor"	Museum app for iPhone that gives them what orientation information they might need, and where they are  Special guides for cane users  Create a consistent system that allows visitors to find the same elements across each section  A system that informs about the crowd numbers in each section (similar to Six Flags with information as to how many people in each game's line)	Each vault with its own personality or identification system using sound, color, and so forth  0342015: regulation norm that determine accessibility in the Work Environment by the Mexican Secretary of Work  Informative pamphlet in braille  Mobile carts available for anyone who wants to ride to each section instead of walk	Lower impact
INTERACTION WITH EXHIBITION ROOM	Staff training and disability sensitization	Specialized staff that can help describe the environment and objects	Beacons	Higher impact
	Special group tours using objects they can touch  Special tours using an inclusivity cart like the AGO  Inclusive activities where vision impaired patrons can interact with other visitors  Sound and distribution adjustments	Inclusive conductive thread  Ways in which they can have an individual cultural experience without a third-party interfering their learning possibilities  An inclusive patriotic policy, enacted through legislation; we are all responsible to take care of our country's people	Inclusive signage  Audio tour  Clear change of floor textures indicating change of sections  Changes in light, temperature or sound effects indicating change of rooms for tactile and audio guidance	Lower impact
INTERACTION WITH EXHIBIT/ OBJECT	Possibility to touch it, or something similar (eg 3D printed object, deaccessioned object)	Buttons to play audios or sounds	Stepping on mats on each exhibit to control the interactions with feet	Higher impact
	Permission to touch texture and shapes or touchable replicas	To hear the actual sound of a specific animal  Use of tactile shapes or pictograms instead of text labels and signs  Braille labels	QR codes system  Accessible writing for information labels/audio  To feel the wind or temperature of an ecosystem	Lower impact

Figure 25. Roadmap of Interventions for Inclusion at the MNHEC

As I approached the end of this project and the end of the Inclusive Design program I drew conclusions about both, my learnings and discoveries, and my personal reflections on the matter of inclusive design, all of them are described on the next section.



## Conclusions

As researcher and author of this Major Research Project I searched to provide an impact in education, having examined many interaction aspects of the museum, and having proposed a different multisensory way to transmit the exhibit content, I believe a contribution was made in terms of enriching the educational edge of the museum and giving the opportunity of an educational experience to more visitors.

It is evident the museum has many challenges to face if it decides to pursue inclusion and develop better experiences for its visitors. Firstly I believe its mission statement needs to evolve so that it compromises new initiatives to what it really wants, and go beyond communicating history, nature and environmental culture. If the MNHEC wishes to actively have an impact on all Mexicans and on the country's education level, it needs to do it intentionally starting with its mission statement and purpose. Secondly it needs to embrace the challenge of becoming inclusive since it is clear the level of accessibility has spiraled up over the last years for the museums field in a global scale. The majority of the museums worldwide have understood the importance of this subject and have started working on changes towards inclusion, so which museum in Mexico will set the example? If museums don't catch up and do something from the beginning of their exhibitions planning, they will later have to retrofeed which will make it more costly and hard to achieve. Thirdly it needs to consider the findings I had during the first round of observations and develop a way to collect feedback, perhaps through formal studies, in order to identify the areas of improvement its exhibitions have and work hard to solve them.

If our intent is to design the future of museums visitors' experience, and the future of collections and objects that have been preserved throughout history, we should think about all possible scenarios we might encounter in the hereafter. If in the future there were to be more seniors

than children or more people with disabilities, then we've gone down the wrong path already solving only for children and for people without disabilities. We are now able to imagine museums of the future whichever way we want and change protocols: we can have museums as open spaces where people could participate and learn through touch, smell, movement, and experience. It is in us to design this. We should also take into account new discoveries in all fields, like education, user experience, and even technology; and search for new ways to educate through museums beyond tours. It is important to mention that my collaboration with the participants in this project allowed me understand that small actions can have a huge impact on people's lives, especially on people who have felt excluded their whole lives by their complete surroundings.

This MRP also made me reflect on how political and bureaucratic the world of museums in Mexico has become over the years, it is a matter we should probably question as well. The moment to deliver the results of the project to the museum is forthcoming and it represents a challenge. How might we communicate this project to the museum's stakeholders in a convincing and interesting way? The project allowed me to learn about inclusion in my country as much as I never had imagined, I discovered there are many initiatives that thrust this matter but there is still a poor culture and little familiarization with disability. At the end of this project I feel responsible for working for a more inclusive environment starting with my local community and I am satisfied to have discovered direct connections to my interaction design profession and passion. The results can be found limited, standard or new for the inclusive design practice, but personally, I started this program overwhelmed thinking it was almost impossible to design inclusively. As I conclude this project I feel surprised of how achievable it was to design with an inclusive perspective.

Interaction Design, Usability and User Experience, my own daily practice, has areas of improvement regarding inclusion too. As I mentioned during the development of the translation and model, the well-known theory about affordances, signifiers and conceptual models is nowadays taught based on visual cues, assuming all users are sighted when interacting with an object. These methods for interaction design could be evolved to multisensory concepts and push these fields towards inclusion and thrive that interaction designers develop a more diverse conception of who **users** are.

During this program and throughout my project I discovered there are clear differences between inclusive design and design thinking. As the user-centered design process keeps evolving and expanding into more areas, designers have become researchers for different fields, for when it comes to creating new solutions, they need to investigate the problems to solve thoroughly. I personally have experienced this working for different companies who search to innovate using design thinking.

There is still the question towards the right method for Inclusive Design. Should it be an adaptation of the Design Thinking process? Or should it in fact, be a new process where new roles are defined? If it were this last, I believe there is a lot to be unlearned from the user-centered methods and a lot to be explored to create a new methodology.

The design thinking process is well known for its user empathy phase, in which designers learn to understand certain type of customers or user behaviors and needs, in order to design a new solution for them. How does this process and this role change when we talk about inclusive design? In her article for Harvard Business Review, *Design Thinking is Fundamentally Conservative and Preserves the Status Quo*, Natasha Iskander talks about this role of

ethnography in Design Thinking as a role in power that makes the decisions for others.

She states:

*"...because the designer herself generates the tacit understandings she uses by connecting empathetically with potential users — the "empathize" mode — whatever needs of product users and communities she perceives are refracted through her personal experience and priorities. As any ethnographer worth her salt will admit, this subjectivity is inevitable, and that is why disciplines that rely on empathetic engagement for data collection stress the importance of paying attention to the researcher's identity and political positioning. The design thinking method does not stipulate rigorous attention to positionality, however. This omission signals that the designer, as creative visionary, is somehow suspended above the fray of bias, blind spots, and political pressure."*<sup>33</sup>

This phase in design thinking is well known to demand empathy, the designer/ researcher is meant to practice getting into the user's shoes and try to understand what he or she feels and how this other person, the subject of the research, faces the world. But this practice comes from a model designers have learned to use that involves synthesis and **generalization**?. So after digging into a series of different profiles, they simplify and create a representative persona of the average customer. But is there a persona that can represent all users to help us design for all? Todd Rose argues in his book *The End of Average*, the average person does not exist, he uses great examples where attempts to use a typical person as a reference, have failed. What Inclusive Design searches is to evolve these Design Thinking methods in a way that design embraces diversity and recognize uniqueness.

---

<sup>33</sup> Natasha Iskander, "Design Thinking Is Fundamentally Conservative and Preserves the ...." 5 Sep. 2018, <https://hbr.org/2018/09/design-thinking-is-fundamentally-conservative-and-preserves-the-status-quo>. Accessed 2 Apr. 2019.

The idea for inclusive design seems to be, not only about designing for a diverse sample where we include extremes, but about including the subjects since the beginning to be research allies. We have been encouraged to co-design, meaning participants are active designers and researchers during the process, for no one can understand ones' needs better than oneself. The designer then adopts of role of collaborator or facilitator so that the ideas and solutions come from each individual.

Therefore, I believe this profession - if it may be called so- requires a new form of humility. An inclusive designer should concede power, credit and control to the user, as it is now the subject, the real researcher. Regarding the term co-design, *The Inclusive Design Guide*<sup>34</sup> developed by the IDRC describes: "The practice of co-design allows users to become active participants in the design process by facilitating their direct input into the creation of solutions that meet their needs, rather than limiting users to the role of research subjects or consultants. When a diverse group of users can participate in the design process, a broader range of needs can be considered throughout the process, from conception to completion. The entire team can participate in quick testing and feedback cycles, and design decisions can be made more quickly.". As ideal as this may sound, I am not sure I agree with it to its full extent.

So far, co-design is meant to be practiced during an ideation phase where it is time to co-create solutions to existing problems. But, what about the rest of the phases? How might we be inclusive from the beginning and all throughout a project?

Ever since I started this program I have noticed this co-design idea hasn't equated detachment from designers to their design solutions. In other words, designers still seem to be the researchers in this process, they invite people as participants of co-design moments, searching

---

<sup>34</sup> "The Inclusive Design Guide - Inclusive Design Institute." Accessed May 15, 2018.  
<https://guide.inclusivedesign.ca/>.

to explore solutions under methods **they** have designed, doing activities **they** have come up with, using methods only **they** know. This doesn't sound like including all along the process, but only when designers consider it important. However, I am not entirely sure of the right way to do it. To co-design this way seems a big step towards inclusion even though I am not convinced it is enough. In her article *The three dimensions of Inclusive Design*<sup>35</sup>, Jutta Treviranus wrote "to apply this dimension of inclusive design requires unlearning many established conventions of design", I second this, and I wonder if there are other measures that can be considered. Throughout my design career I have learned established methods that have been proven to work successfully in solving problems in a creative way; to unlearn means a lot of what I have learned and practiced up to now can be questioned and redefined in order to become inclusive.

As strategic designers and researches we are taught to treat subjects of interest as part of our methodology, but not as frequently as designers as well. We are trained to search for patterns rather than to identify particularities; to create simple rather than complex; to interpret -which can fall into assumptions- and therefore be owners of the findings and insights that come from people alien to us.

This project, along with all the projects I was able to learn from, during the Inclusive Design program helped construct my perception of inclusive design methods, I strongly believe they are too informed by user-centered methods and have still a long way to travel towards becoming a new methodology. As inclusive designers, we should help develop new methodologies and try to avoid repeating practices that have worked for a long time, only for

---

<sup>35</sup> "The Three Dimensions of Inclusive Design: Part One - Medium." March 28, 2018.  
<https://medium.com/fwd50/the-three-dimensions-of-inclusive-design-part-one-103cad1ffdc2>.

average-user-centered solutions. The same way design thinking is been used more and more often for so many different contexts, the same way Inclusive Design could be adopted and redefined constantly until it achieves authentic inclusion, in a way it reaches equality for everyone.

Ever since I started this program I have paid more attention to inclusion and accessibility practices that different services and companies have implemented. What I have realized is that these adaptations are often carried out by companies as a result of an obligation imposed by legislation, but they do not necessarily solve the real problems. As examples: adding ramps, having special initiatives and programs, both things seemingly carried out separately for people with a certain disability.

Does it mean including who it is convenient to include in terms of volume or revenue opportunity? Or does it mean giving opportunities to those who don't have them yet?

Little effort has been made to include minority groups such as people with physical or intellectual disabilities, and as technology moves faster each year, the lack of attention for those who are being left behind gets wider. The more digitized services we have, the more difficult it will become to offer a customizable experience. The less human contact, the less chance for adaptation to diverse groups.

This may be due to the fact that people and institutions in Mexico have not understood differences between inclusion and accessibility. We are still at the point where we may think

including means adapting what is there, for a certain minority's to access it. When I think about the services offered by many of the public institutions I see, they do not seem to be designed to be used by people with a disability or a different characteristic other than the majority of the Mexican population. The elderly or people with other languages are examples of those who appear to be underserved.

Technology has brought benefits for inclusion, for example, giving independence and control to customers through apps or web services. When well developed, these can be customizable, and therefore accessed by a more diverse population of clients. Technology is now intended to help, instead of complicate. Meaning it represents a bigger chance to be inclusive, to expand opportunities instead of limit them.

There is definitely a huge challenge to change mindsets and paradigms. To transform the way people think of access and inclusion. But this can be achieved step by step by creating solutions at all levels: internally, employment-wise, products and services-wise, and technology-wise.

During this program I have seen different examples of inclusive designs for diverse subjects, and I am convinced, more than ever, that there is space for inclusion in all areas and industries, there is a chance for us to work holistically with inclusion in our jobs, and spread best practices to other companies. I do believe it needs to start internally though, so questioning the employers as to why there aren't better programs that promote diversity in-house could be a great first step.



## Next Steps

As I did some desktop research of other public projects (because the MNHEC is public) that have worked in other countries where their government took action and I found a project from the UK Government Digital Service,<sup>36</sup> where a published video shows the results of an improved public service recording the testimony of a woman benefited by this project; the woman talks with genuine gratitude, making the video very emotional; it helped me realize emotional material can be effective when the aim is to demonstrate the impact a project has in people's lives. Government and public initiatives tend to report on the successful impact they have in a population in society at large scales, but if a project addresses small populations then it must show deep impact in lives with an emotional connotation. This MRP may seem to benefit the blind population only, but in fact, techniques to translate exhibits to multisensory interactions and the suggested roadmap aim at a broader goal that is to help the museum become inclusive by allowing it to interact with a wider, more diverse public.

During the last weeks of the program, towards the end of April, 2019, a recap about this MRP and its deliverables were presented to the museum's stakeholders. The reactions and comments were highly positive and encouraging.

The Director of the MNHEC asked me to continue the work with the museum at three different levels: the first level would approach the remodelling plans for the next vaults where she asked me to present with her, all of the findings and recommendations to Siete Colores so that she emphasises the importance of considering accessibility and inclusion in the design of the future exhibitions; the second level would be working with the museum's staff and consists of

---

<sup>36</sup> "Make a lasting power of attorney on GOV.UK - YouTube." Accessed January 5, 2019. <https://www.youtube.com/watch?v=GY-NpWFyu8w>.

workshops and sessions to learn more about how to approach visitors with disabilities and how to develop simple ideas that can help improve the visitors' experience from their role as tour-guides; and at the third level she asked to work on a formal strategic project with specific actions the museum could take, so that she presents the proposal to the institution's top stakeholders and asks them for the required resources and budget.

This response seems promising for the continuation of this project and possible outcomes that have a strongest impact on the museum.

## Bibliography

Art Gallery of Ontario. "Access to art group visits, Multisensory Group Visits." Accessed December 28, 2018. <https://ago.ca/group-visits/access-art-group-visits>

Ávalos, Franco, C., and Vázquez, Rosario, U. "Estudio visitantes a museos." CONACULTA, December, 2011, [https://sic.gob.mx/estudios\\_publico/17.pdf](https://sic.gob.mx/estudios_publico/17.pdf)

Cooper Hewitt Museum. "Exhibitions: Access+Ability." Cooper Hewitt. July, 2018. Accessed September 5, 2018. <https://collection.cooperhewitt.org/exhibitions/1141959921/>

Cooper Hewitt Museum. "Exhibitions: The Senses: Design Beyond Vision." Cooper Hewitt. July, 2018. Accessed September 5, 2018. <https://www.cooperhewitt.org/channel/senses/>

Eardley, Alison F., Clara Mineiro, Joselia Neves, and Peter Ride. "Redefining Access: Embracing multimodality, memorability, and shared experience in Museums." In the Museum Journal, 2016. Vol.59. No. 3: 263-286.

El Universal. "¿Cuánto cuesta visitar los museos de la Ciudad de México?." *El Universal*, December 29, 2019. <http://www.eluniversal.com.mx/destinos/cuanto-te-cuesta-dar-un-tour-por-los-museos-de-la-cdmx>

Farrell, B., Medvedeva, M., Cultural Policy Center., NORC and the Harris School of Public Policy at the University of Chicago. "Demographic Transformation and the Future of Museums." The AAM Press, American Association of Museums, 2010. Accessed December 2, 2017. <https://www.aam-us.org/wp-content/uploads/2017/12/Demographic-Change-and-the-Future-of-Museums.pdf>

Government Digital Service. "Making a lasting power of attorney in GOV.UK." Published on August 2, 2015. Youtube video. Accessed January 5, 2019. <https://www.youtube.com/watch?v=GY-NpWFyu8w&feature=youtu.be>

Government of Mexico City. "Expenses Budget Project 2016." Instituto Electoral Ciudad de México. Accessed January 18, 2018. [www.iedf.org.mx/transparencia/art.14/14.f.01/marco.legal/DecretoPresupuesto2016.pdf](http://www.iedf.org.mx/transparencia/art.14/14.f.01/marco.legal/DecretoPresupuesto2016.pdf)

Government of Mexico City. "Ley para la Integración al Desarrollo de las Personas con Discapacidad del Distrito Federal (Law for the Integration to Development of People with Disability for Mexico City)." Asamblea Legislativa del Distrito Federal. March, 2016. Accessed February 3, 2019. <http://www.aldf.gob.mx/archivo-b28392e3c828c3108d8b0873830eb35d.pdf>

Government of Mexico City. "Red de Museos para la Atención a Personas con Discapacidad (Museums Network for the Attention towards People with Disability)." INDEPEDI. Accessed February 2, 2018. <http://data.indepedi.cdmx.gob.mx/museos.html>

Government of Mexico. "Cloudy Forests." Government of Mexico." Biodiversidad Mexicana. Accessed September 19, 2018.

<https://www.biodiversidad.gob.mx/ecosistemas/bosqueNublado.html>

Hayhoe, Simon. "Philosophy as Disability & Exclusion." IAP, 2015. Accessed March 2, 2018.

[https://books.google.com.mx/books?id=4gYoDwAAQBAJ&dq=Philosophy+as+Disability+%26+Exclusion&hl=es&source=gbs\\_navlinks\\_s](https://books.google.com.mx/books?id=4gYoDwAAQBAJ&dq=Philosophy+as+Disability+%26+Exclusion&hl=es&source=gbs_navlinks_s)

Inclusive Design Research Centre. "The Inclusive Design Guide." Accessed May 15, 2018.

<https://guide.inclusivedesign.ca/>

Iskander, Natasha. "Design Thinking is Fundamentally Conservative and Preserves the Status Quo".

Harvard Business Review, September 5, 2018. Accessed April 2, 2019.

<https://hbr.org/2018/09/design-thinking-is-fundamentally-conservative-and-preserves-the-status-quo>

Jiménez del Arco, Mercedes. Director of the Natural History Museum Mexico City. In-depth interview by author, December 6, 2017.

Levent, Nina, and Alvaro Pascual – Leone. "Introduction. In the Multisensory Museum: Cross-Disciplinary Perspectives on Touch, Sound, Smell, Memory, and Space." (Ed. Nina Levent and Alvaro Pascual-Leone), 2014. New York: Rowman and Littlefield.

Lobato, Jaime. "Transmutation: Space Alchemies." Catalog from Jaime Lobato's exhibition, curated by Paloma Oliveira. August, 2017. [https://issuu.com/palomabase/docs/cuadernillo\\_jaime\\_ingles](https://issuu.com/palomabase/docs/cuadernillo_jaime_ingles)

M. Chung, Christina. "Sacrificial Concepts." Medium. January, 2016. Accessed October 27, 2018.

<https://medium.com/@christinamchung/sacrificial-concepts-200993246364>

Meissner, Janice Lena, John Vines, Janice McLaughlin, Thomas Nappey, Jekaterina Maksimova and Peter Wright. "Do-It-Yourself Empowerment as Experienced by Novice Makers with Disabilities." Proceedings of the 2017 Conference on Designing Interactive Systems. Pages 1053-1065. Edinburgh, United Kingdom, June 10-14, 2017.

[http://delivery.acm.org/10.1145/3070000/3064674/p1053-meissner.pdf?ip=189.167.0.141&id=3064674&acc=OA&key=4D4702B0C3E38B35%2E4D4702B0C3E38B35%2E4D4702B0C3E38B35%2E7A1304C7E80C9A09&\\_\\_acm\\_\\_=1552182387\\_95f8d5106df9fc0b24cd5278d5ba2554](http://delivery.acm.org/10.1145/3070000/3064674/p1053-meissner.pdf?ip=189.167.0.141&id=3064674&acc=OA&key=4D4702B0C3E38B35%2E4D4702B0C3E38B35%2E4D4702B0C3E38B35%2E7A1304C7E80C9A09&__acm__=1552182387_95f8d5106df9fc0b24cd5278d5ba2554)

Mesz, Bruno, Marcos A. Trevisan and Mariano Sigman. "The Senses: Design Beyond Vision. Taste of Music, 2011." Database on-line. Cooper Hewitt. Accessed September 5, 2018.

<https://collection.cooperhewitt.org/objects/1159162397/>

Mexican Government, INAH. "Sistema Institucional Estadística de Visitantes." Accessed February 3, 2018. <http://www.estadisticas.inah.gob.mx/>

Museum of Science. "Universal Design for Museum Learning Experiences." Accessed January 20, 2018.

<https://www.mos.org/UniversalDesign>

Museums Association. "Valuing Diversity: The Case for Inclusive Museums." Arts Council England, 2016.

Accessed December 4, 2017. <https://www.museumsassociation.org/download?id=1194934>

Oliveira, Paloma. "Lectures: Museography and Accessibility." Portfolio of Paloma Oliveira. 2016. Accessed November 28, 2017.  
<http://www.discombobulate.me/en/workshop/inclusao/>

Papalia, Carmen. "A New Model for Access in the Museum." In *Disability Studies Quarterly*, 2013. Vol 33 (3) 1-16.

Secretaría del Medio Ambiente, Ciudad de México. "México Megadiverso. Conjunto Cuatro Bóvedas." Museo de Historia Natural. Last Modified May, 2018. Accessed May 23, 2018.  
<http://data.sedema.cdmx.gob.mx/museodehistorianatural/index.php/exhibiciones-y-colecciones/exhibiciones-permanentes/conjunto-cuatro-bovedas>

Secretaría del Medio Ambiente, Ciudad de México. "Quienes somos (About us)." Museum of Natural History and Environmental Culture, Mexico City. Accessed January 20, 2018.  
<http://data.sedema.cdmx.gob.mx/museodehistorianatural/index.php/quienes-somos/mas-sobre-el-museo-de-historia-natural/>

Secretaría General Iberoamericana. "XVII Cumbre Iberoamericana de Jefes de Estado y de Gobierno." III Reunión de coordinadores nacionales y de responsables de cooperación (November 5-7, 2007).  
<http://segib.org/wp-content/uploads/INICIATIVA-IBERMUSEOS.pdf>

Sietecolores Ideas Interactivas. "Projects: Museo de Historia Natural." Accessed January 13, 2018.  
<http://sietecolores.mx/en/>

Treviranus, Jutta. "The Three Dimensions of Inclusive Design." Medium. March 28, 2018.  
<https://medium.com/fwd50/the-three-dimensions-of-inclusive-design-part-one-103cad1ffdc2>

Udacity. "Intro to The Design of Everyday Things: Affordances and Conceptual Models." Published on February 23, 2015. Youtube video. Accessed October 27, 2018.  
<https://www.youtube.com/watch?v=a6F0EYCUjcE>

Wellbeloved-Stone, Clair. "Accessibility at the Museum of Tomorrow." Bluetrunk. March, 2019. Accessed March 2, 2019. <https://bluetrunk.org/accessibility-at-the-museum-of-tomorrow/>

Wittman, A., Paquet, R. "The Inluseum: How can we make museums more inclusive?." Think Inclusive, December 6, 2015.  
<https://www.thinkinclusive.us/inluseum-inclusive-museum/>

## Appendix

### Appendix A. My MRP process in relation with divergent and convergent thinking

To address the research question I went through a series of phases, changing between divergent and convergent thinking correspondent to user centered design methods as shown in Figure x below.

Divergent thinking was used during the phases when the goal was to generate a large amount of creative ideas through research and exploration of possible solutions, without thinking of limitations, allowing as much information as possible to enter the process. Convergent thinking followed after the divergent thinking by organizing and structuring the ideas gathered and setting limitations, filters and conditions to make defining decisions. The following model represents my process:

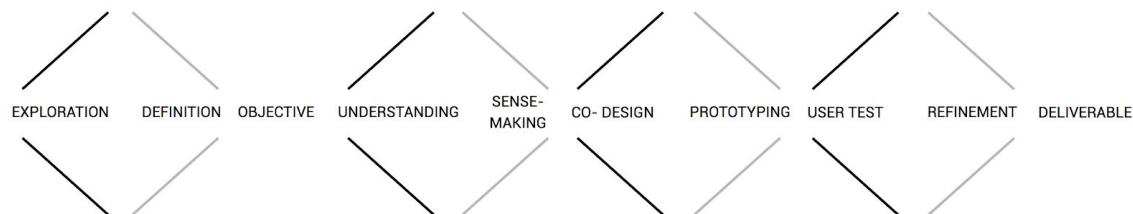


Figure 26. My MRP process in relation with divergent and convergent thinking

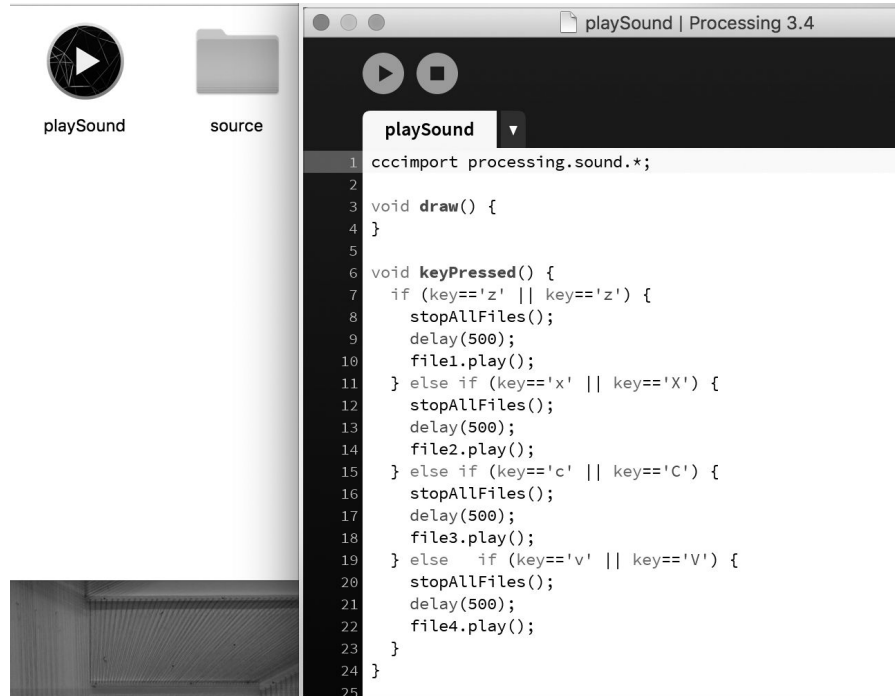
### Appendix B. Timeline of museum during MRP

- January 2018: Introduction to Museum's Director, notice of soon to open remodeled exhibitions
- January to April 2018: First conversations with stakeholders, observations and desktop research
- April 2018: Opening of new remodeled exhibitions
- April to August 2018: More conversations with stakeholders and observations, synthesis while doing REB application
- September 2018: REB Application approved
- September 2018: Recruitment and shadowings interviews
- October 2018: Co-design and prototyping
- December 2018: User test
- December 2018 and January 2019: Synthesis, refinement and strategies definition

## Appendix C. Participants sample for shadowing interviews

- Participant A: Female, 25 years old, in a wheelchair. She can only detect large shapes but sees them poorly. When she is able to get objects right in front of her eyes, she can see colors.
- Participant B: Male, 28 years old, he was born blind. He doesn't use any form of assistance.
- Participant C: Female, 37 years old, she lost sight towards finishing college, she can see the background general light color. She has a guide dog.
- Participant D: Male, 37 years old, he was born blind. He uses a cane.
- Participant E: Female, 42 years old, she was born blind, she uses cane since she was 10.
- Participant F: Female, 43 years old, she was born blind, she has a guide dog.
- Participant G: Male, 45 years old, he was born blind, he has a guide dog.
- Participant H: Female, 47 years old, she was born blind, she doesn't use any form of assistance.
- Participant I: Male, 54 years old, he lost his sight at the age of 12. He has used a cane since he was 13.
- Participant J: Male, 55 years old, he lost sight at the age of 4 due to measles, he has used cane since he was 15 years old. He knows and teaches braille.
- Participant K: Female, 57 years old, partially lost sight at the age of 12 and in 2000 she lost her sight completely. She uses cane since 2000.
- Participant L: Female, is 65 years old, she lost sight completely 6 years ago. She uses cane since she lost sight.
- Participant M: Female, born with neurofibromatosis, she lost sight at the age of 19, she can only see with her right eye and only when facing the front, she cannot detect shapes to the sides.

## Appendix D. Code in Processing for prototype buttons



```
25
26 SoundFile file1, file2, file3, file4;
27
28 void stopAllFiles(){
29   SoundFile[] files = {file1, file2, file3, file4};
30   for (int i = 0; i < files.length; i++) {
31     if(files[i].isPlaying()){
32       print("IS PLAYING");
33       print(i);
34       files[i].stop();
35     }
36   }
37 }
38 void setup() {
39   size(640, 360);
40   background(255);
41
42   // Load a soundfile from the /data folder of the sketch at
43   file1 = new SoundFile(this, "1.mp3");
44   file2 = new SoundFile(this, "2.mp3");
45   file3 = new SoundFile(this, "3.mp3");
46   file4 = new SoundFile(this, "4.mp3");
47   //file.play();
48 }
49
```



## Appendix E. First round of participants ideas per field of action

Diffusion and drivers: how do people with vision impairment find out about the museum and plan their visit?

Ideas:

- An accessible website for the museum
- Information about accessibility in the museum on the internet
- Accessible coordinates and instructions to get to the museum
- Broadcasting of inclusive practices in the museum
- Advertising and awareness creation through inclusion organizations

Navigation: how do people with vision impairment navigate through the museum?

Ideas:

- Interactive tactile map at the entrance
- Museum app for iphone that gives them what orientation information they might need, and where they are
- Tactile floors at key junctions

Interaction with the exhibition room: how do people with vision impairment approach an exhibition and what influences their journey?

Ideas:

- Beacons
- Audio tour
- Special group tours using objects they can touch
- Special tours using an inclusivity cart like the AGO\*\*\*
- Tactile floors
- Sound and distribution adjustments
- Inclusive signage
- Inclusive conductive thread

Interaction with the exhibit: how do people with vision impairment interact with an exhibited object and how do they comprehend it?

Ideas:

- Braille labels
- Audio descriptions
- Possibility to touch it, or something similar (eg 3D printed object, deaccessioned object)

## Appendix F. Second round of participants ideas per field of action

Diffusion and drivers: how do people with a vision impairment find out about the museum and plan their visit?

Ideas:

- + Audio on website introducing the museum
- + Audio signage at the Chapultepec Forest that helps get to the museum

Navigation: how do people with vision impairment navigate through the museum?

Ideas:

- + Special guides for cane users
- + 0342015: regulation norm that determine accessibility in the Work Environment by the Mexican Secretary of Work.
- + Create a consistent system that allows visitors to find the same elements across each section
- + Informative pamphlet in braille
- + Each vault with its own personality or identification system using sound, color, and so forth
- + At the entrance, a welcoming audio to confirm we arrived at the right place, like the *Torre Mayor building that has an audio reproduced every time it senses people approaching saying "Welcome to the Torre Mayor"*.
- + Indicators where the restrooms are
- + Mobile carts available for anyone who wants to ride to each section instead of walk
- + An inclusive feedback section for visitor comments
- + A system that informs about the crowd numbers in each section (similar to Six Flags with information as to how many people in each game's line.

Interaction with the exhibition room: how do people with vision impairment approach an exhibition and what influences their journey?

Ideas:

- + Staff training and disability sensitization
- + Clear change of floor textures indicating change of sections
- + Changes in light, temperature or sound effects indicating change of rooms for tactile and audio guidance
- + Specialized staff that can help describe the environment and objects
- + Inclusive activities where vision impaired patrons can interact with other visitors
- + Ways in which they can have an individual cultural experience without a third-party interfering their learning possibilities.

- + An inclusive patriotic policy, enacted through legislation; we are all responsible to take care of our country's people

Interaction with the exhibit: how do people with vision impairment interact with an exhibited object and how do they comprehend it?

Ideas:

- + QR codes system
- + Permission to touch texture and shapes or touchable replicas
- + Use of tactile shapes or pictograms instead of text labels and signs
- + To feel the wind or temperature of an ecosystem
- + Buttons to play audios or sounds
- + Stepping on matts on each exhibit to control the interactions with feet
- + To hear the actual sound of a specific animal
- + Accessible writing for information labels/audio

## Appendix G. User test complete report

Date: Saturday from 10:00 am to 1:00 pm

Natural History Museum- Mexico City, Mexico

### 1. Number of visitors and basic demographic information:

- Approximately 60 visitors in total.
- 30 children, boys and girls from four to eleven years old
- Around 10 teenagers, boys and girls from twelve to sixteen years old
- Around 10 adults, from twenty to fifty years old
- 1 blind adult: female, twenty six years old
- 1 blind adult: female, thirty two years old
- 10 seniors, sixty years old and older.
- 1 senior: female, eighty four years old with Alzheimer's disease

### 2. What type of interaction was provided for each visitor?

- explanation of interactions: very low, only four visitors asked how to interact with the prototype and 13 of the visitors asked if they could touch the tactile representation.
- explanation of concept: most visitors read the description and disclaimer and only two women asked about the concept and reasoning of the prototype.

### 3. What questions did visitors ask?

About interactions:

- Some asked if they were free to touch the tactile representation. They came from looking at other areas of the museum where they are not allowed to touch so I could tell they felt uncertain if they could.
- Very few asked how to open the smell output.
- The best engagement happened when I stepped away from the prototype stand and people would come on their own and start exploring, they would start touching immediately (see the buttons findings at the end of this doc.).
- About purpose of the translation:
- Only two women asked about the prototype and project, most visitors understood it as an extension of the diorama, and assumed it was a temporary activity held by the museum (they thought I was one of the guides).

About the artwork or anything else:

- Many asked for the name of the grey bear-shaped animal (Tapyr).
- A few asked about the region, where it was found and if it was endangered.

- About five asked if the region still existed or was destroyed.
- Two people asked for the name of the plants represented.
- Some children didn't ask, but went looking for the Jaguar at the back of the diorama after touching and seeing it in the tactile representation.
- Three teenagers asked about other subjects they couldn't find information about and they needed to do their homework.

4. What did the visitor grasp about the translation most effectively (in your opinion, or ask them)

- The sensation of touching the ground, the rocks, the trees and the shape of the animals.
- The fresh smell of the pines.
- Eight adults left the audio running as they touched and smelled, and listened to new information about what animals and plants are found there, what is produced in this region and what the weather is like there. They all looked surprised and repeated this information to their children.

5. Based on your observations, and visitor feedback, how could the strategies that you identified to produce a multisensory translation be improved?

- Blind visitors could benefit from touching more realistic animals' skin or fur.
- All visitors could benefit from having more plants to smell, they all loved this.
- All visitors could benefit from touching each element with more space in between to concentrate on each element and have audio correspondent to each: as they touch the Jaguar, they could listen to its description and real sound. Same for each element.

8. How did the visitor perceive the scale of the artwork itself or the elements depicted by the artwork?

- Most thought it was fun to have it smaller but each element in correct scale .
- They mentioned size because they weren't able to move their hands in between objects with much freedom, and I was able to observe that when reaching out for the tactile representation, a few people bumped the buttons accidentally and changed the audios because they were in the way.
- The person in a wheelchair had trouble reaching the smell output, and also had to reach far to touch the tactile representation.

9. How did the visitor perceive the more abstract conceptual aspects of the artwork (for example, the economic status of the person depicted, the season, etc.)?

- They put attention to the beginning of the audios, but wished they were shorter and clearer with only interesting facts.

- Audios helped them know more but they concentrated more on the prototype because they were touching and exploring while listening to them.
- The smell was a great hit, it awakened curiosity, and they all felt like it gave them a better idea of what that forest is like, some started talking about their own trips to forest areas and what they like the most about them, by memory. As they smelled many would answer the question from the audio “what smell do you recognize?” with “it smells like that!” signaling the tactile forest representation.

## Appendix H. Questionnaires

### Contextual interviews

Hi there! I'm working on a project to improve the museum's experience, would you mind answering a few questions?

What brings you to the museum today?

Had you been here before?

What was your favorite part of the museum? Why?

What has been your favorite exhibit? Why?

What could be improved?

Thank you!

### Shadowing interviews

#### INTRODUCTION

What is your name?

How old are you?

Where are you from?

Tell me a little more about yourself, what are your favorite hobbies? why do you like this?

#### VISUAL IMPAIRMENT

How long have you been having difficulty to see for?

What type of impairment do you have?

What assistance do you use?

Do you use any assistive technology? which? why? why not?

#### MUSEUM CONTEXT

Have you been to museums before? which? why?

What did you like the most? what did you not like?

Have you been to this museum before? what was it like?

What do you expect to experience in this visit?

#### UPON ENTERING MUSEUM

From now on, I would like you to think aloud and let me know everything you are perceiving.

I will be letting you know where we are headed towards and what visitors are looking at.

If you have any questions or need anything please let me know.

#### DURING VISIT

We are now entering an exhibition called Megadiverse Mexico.

We are going through a 4 meter long corridor...

What do you think?

Have you heard about this before?

## AT THE END OF THE VISIT

What did you think?  
How did you feel?  
What did you like the most?  
What did you like the least?  
What do you think should be changed? why?  
How would you improve it?  
Would you like to come back? why? why not?

## THANK YOU AND NEXT STEPS

Is there anything else you would like to add?

Thank you so much for your participation. As I explained before, I will be coming to the museum with other participants to do the same activity.

The next touchpoint will be a co-design session with all of the participants together.

This will take place in about three months time.

I will contact you and set the date, if you wish to continue with the project, I will meet you then and we will work on new ideas to improve this visit.

¡Have a great day!

## Co-design sessions

### INTRODUCTION

Let's all introduce ourselves, please tell everyone your name, age and something you want to share about yourself. It may be your favorite hobby, or anything you find interesting about yourself.

As you all know, this is the second touchpoint for all of you. Each one of you has gone to the museum and has lived the experience with the current exhibitions. Today we are going to talk about our general impressions, common problems we all faced, and we will come up with ideas to solve them.

### GENERAL RULES OF THE GAME

Today we are at an open space where we need to respect everyone's opinion.

We will talk one person at a time, respect the schedule and engage in the activities accordingly.

If at any point you need to leave, make a pause or take a break, please let me know.

For ideation there are some rules we need to respect:

Negative comments such as "that is impossible", or "that cannot be done", are prohibited.

Try to construct upon other people's ideas.

Listen and respect when somebody is sharing an idea or thought.

Everything is possible and welcome today, there aren't any crazy ideas or dumb ones, all ideas can become great solutions!

Everyone here has a different perspective, that's what will make our ideas more rich and powerful: diversity!



## CURRENT BARRIERS AT THE MUSEUM

1. I will read out loud some of the problems you all mentioned during your visits, I would like you to listen, and then say out loud if there were others that I haven't mentioned that you think think are important.
2. Great! Now I would like you all to take a sticker (moderator hands out stickers), and I would like you to raise your hand with the sticker when I read out the problem you find most grave.
3. Excellent. We now have the three main problems you all think are the most grave. We will now do some activities to come up with ideas for each problem.

## IDEATION

Different ideation activities will be specially designed to diverge and push disruptive ideas. The activities will be structured and inspired by different levels of baselines such as sound, touch and smell sources.

## THANK YOU AND CLOSURE

That was all! Does any of you have more comments or recommendations?

Thank you all for participating, our next touchpoint will be in two to three months time. In the meantime, I will share with you all the conclusions for this session in a written format. If you have any questions don't hesitate to contact me.

## User tests

### INTRODUCTION

What is your name?  
How old are you?  
Where are you from?  
Tell me a little more about yourself, what are your favorite hobbies? why do you like this?

### VISUAL IMPAIRMENT

How long have you been having difficulty to see for?  
What type of impairment do you have?  
What assistance do you use?  
Do you use any assistive technology? which? why? why not?

### MUSEUM CONTEXT

Have you been to museums before? which? why?  
What did you like the most? what did you not like?  
Have you been to this museum before? what was it like?  
What do you expect to experience in this visit?

### PROTOTYPE TESTING

I will now ask you to use this device (if there is any), and follow my instructions:

From now on, I would like you to think aloud and let me know everything you are perceiving.  
If you have any questions or need anything please let me know.

#### AT THE END OF THE TEST

What happened?  
Can you describe what you just went through?  
What did you think?  
How did you feel?  
What did you like the most?  
What did you like the least?  
What do you think should be changed? why?  
How would you improve it?  
Would you like to come back? why? why not?

#### THANK YOU

Is there anything else you would like to add?

Thank you so much for your participation. We hope we can create a better experience for you at the museum.

¡Have a great day!

## Appendix I. Complete list of dioramas in Megadiverse Mexico section

- Bosque mesófilo de montaña. El Triunfo, Chiapas. (Forest)
- Selva tropical húmeda. Montes Azules, Chiapas. (Jungle)
- Selva tropical seca. Huatulco, Oaxaca. (Jungle)
- Bosque de coníferas y encinos. Bassaseachic, Chihuahua. (Forest)
- Desierto de cactáceas. Tehuacán, Puebla. (Dessert)
- Matorral desértico. El vizcaíno. Baja California Sur. (Dessert)
- Pradera de alta montaña. Volcán Popocatepetl, Puebla. (Prey)
- Cueva de murciélagos. Calakmul, Campeche. (Cove)
- Ventila hidrotermal. Cuenca de Guaymas, golfo de california.
- Zona intermareal. Isla Espíritu Santo, Baja California Sur. (Deep ocean)
- Arrecife de coral. Sian ka'an, Quintana roo. (Coral reef)
- Manglar. La encrucijada, Chiapas. (Mangrove swamp)
- Laguna costera. Marismas nacionales, Nayarit. (Coastal lagoon)